

FIG. 1A

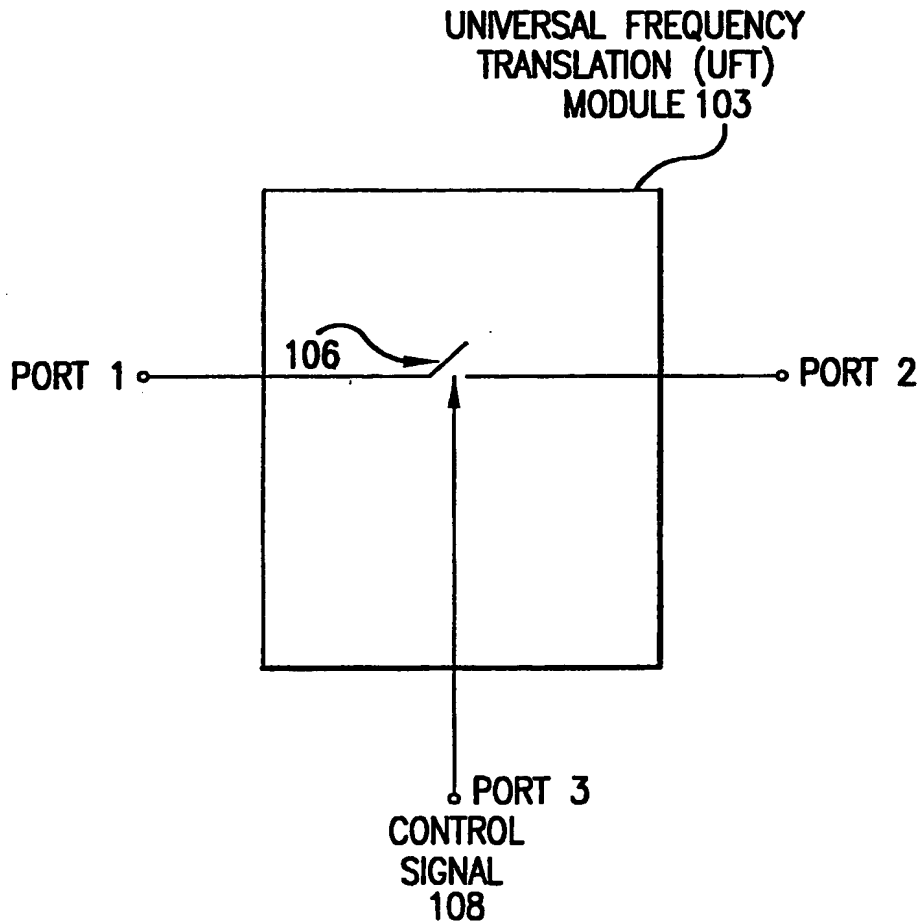


FIG. 1B

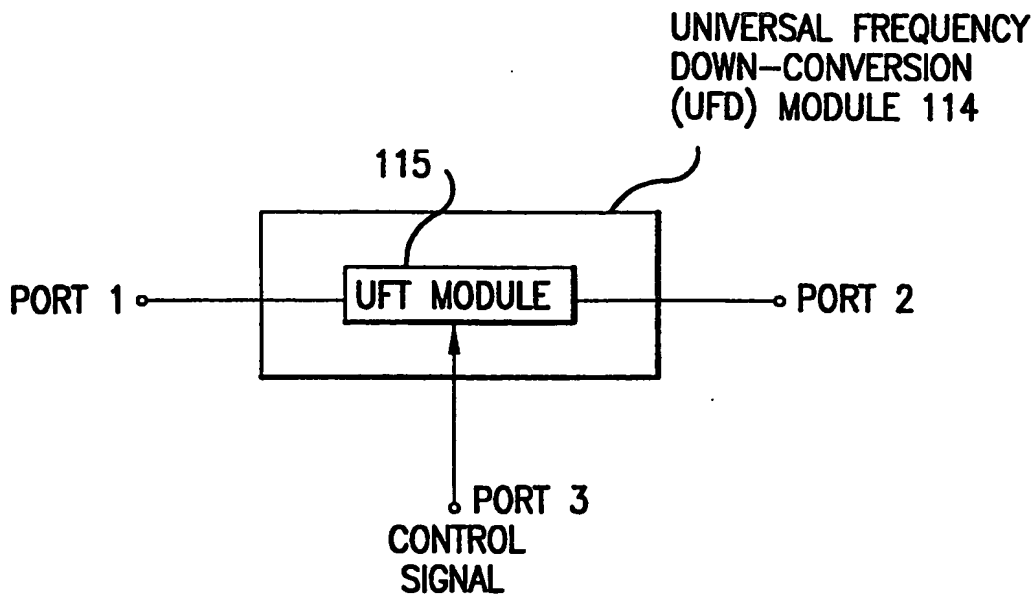


FIG. 1C

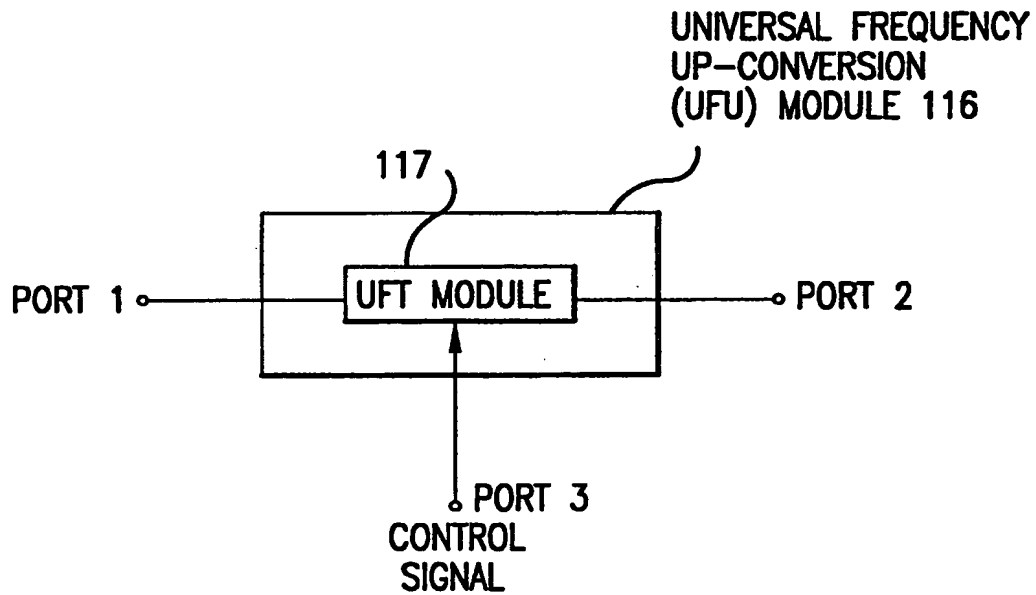


FIG. 1D

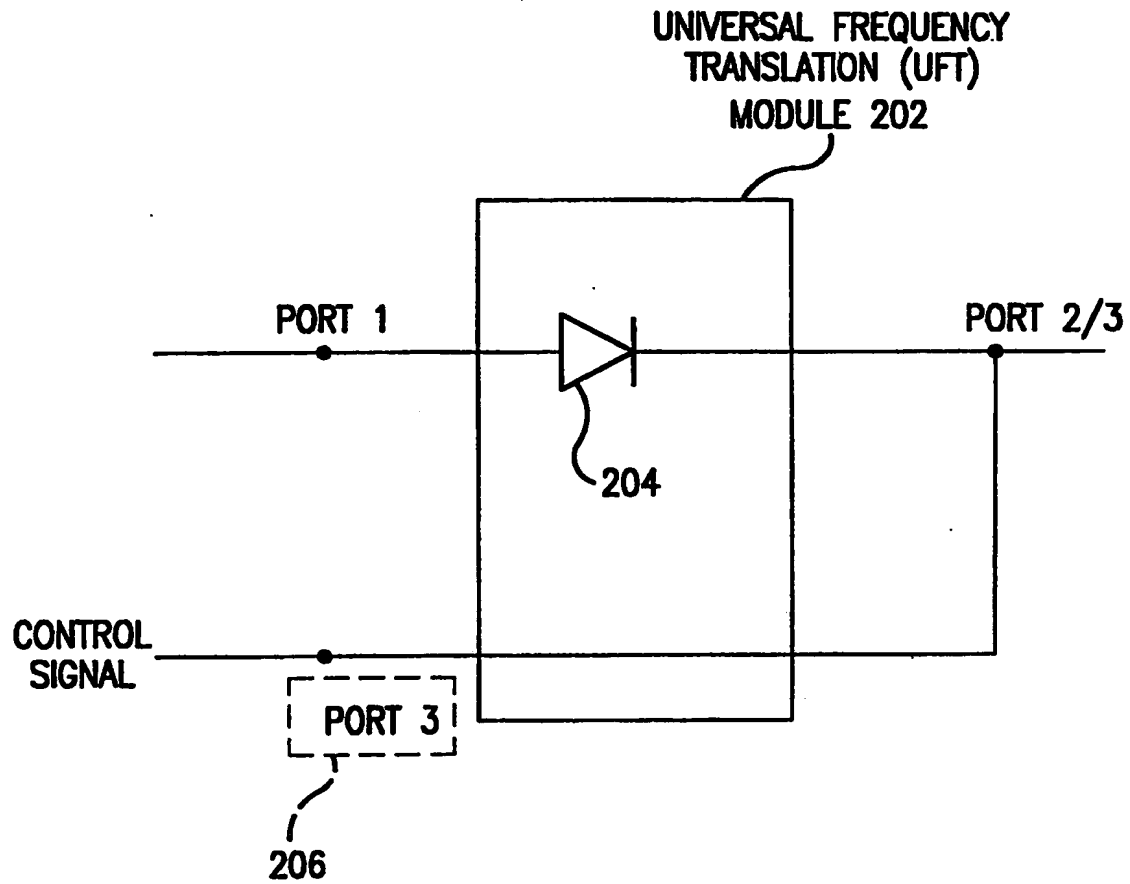
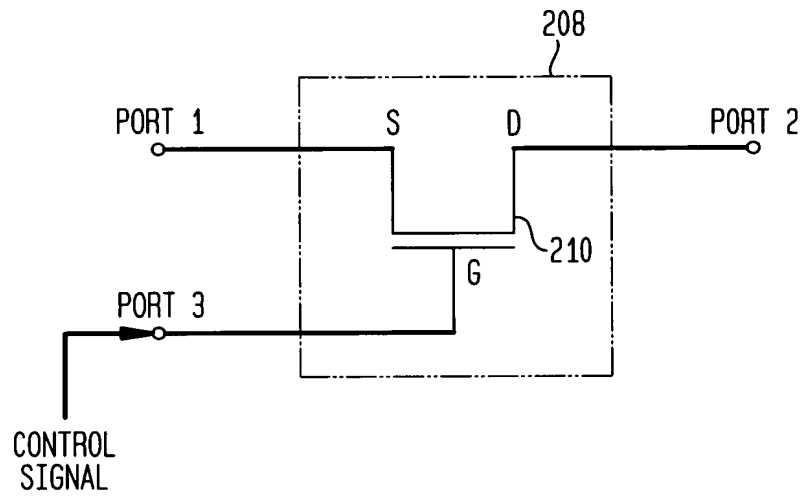


FIG. 2A

FIG. 2B



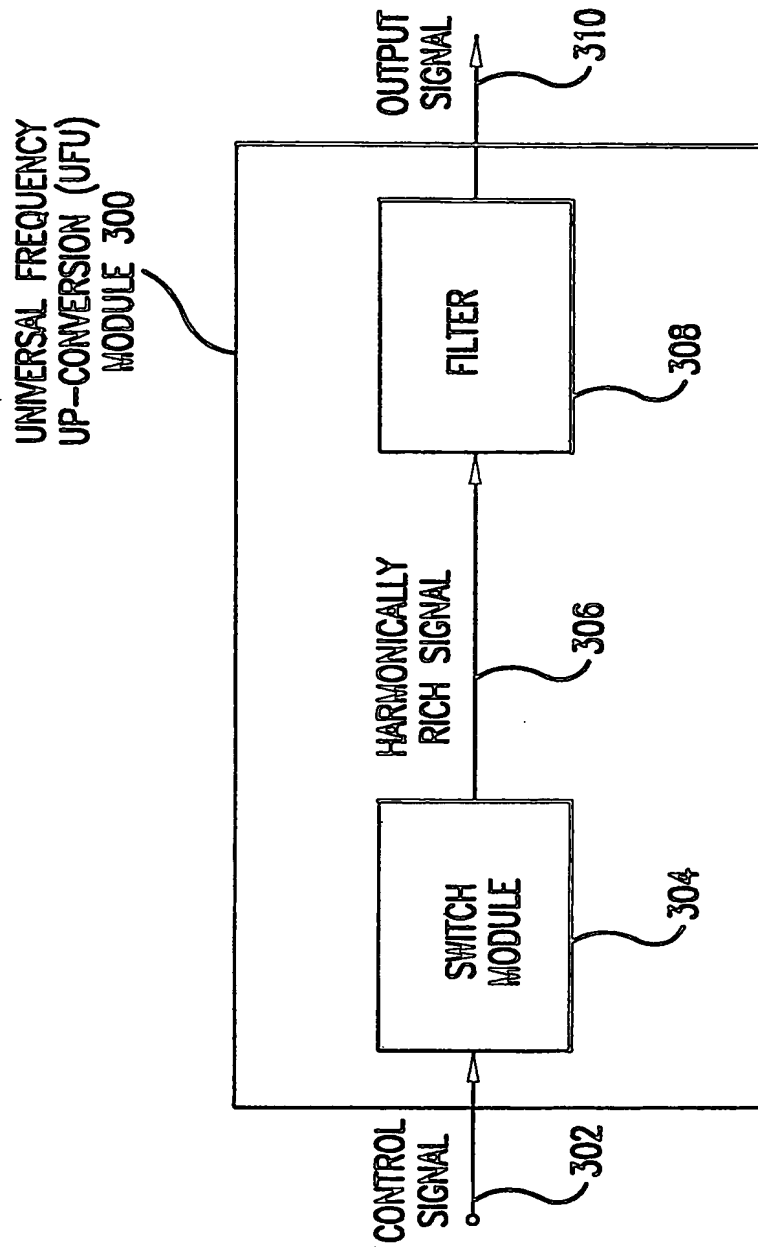


FIG. 3

UNIVERSAL FREQUENCY
 UP-CONVERSION (UFU)
 MODULE 401

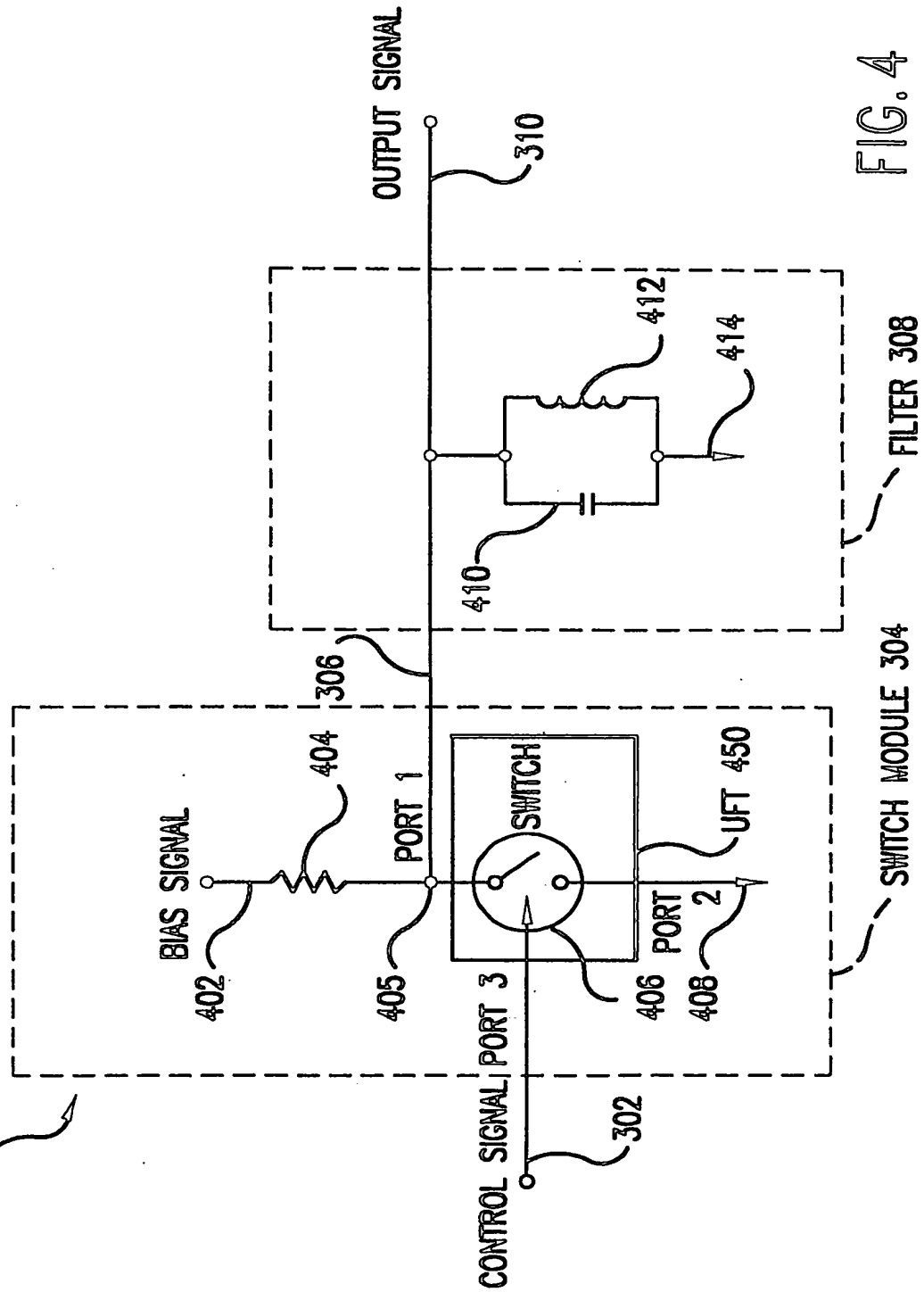


FIG. 4

UNIVERSAL FREQUENCY
 UP-CONVERSION
 (UFU) MODULE 590

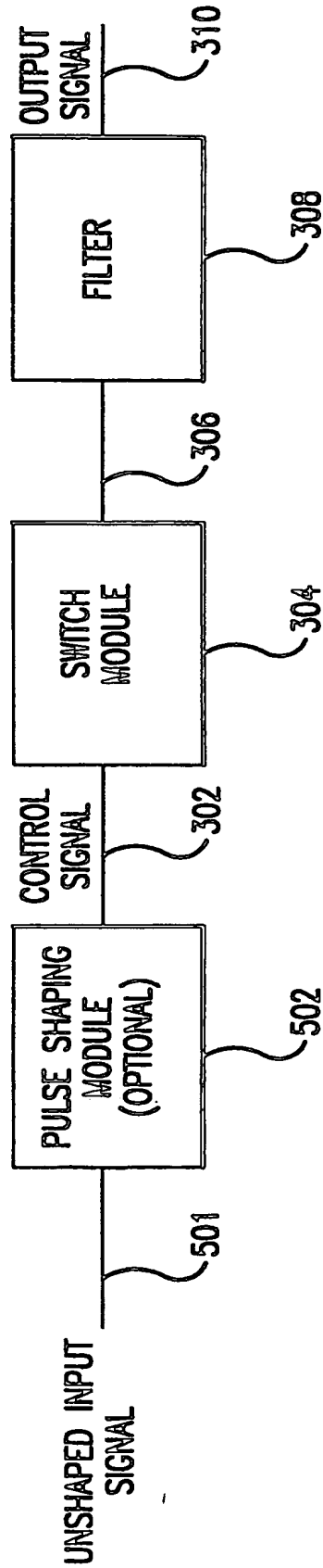
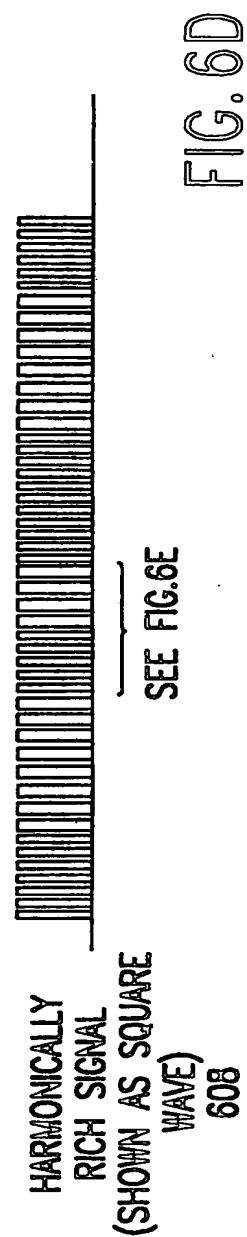
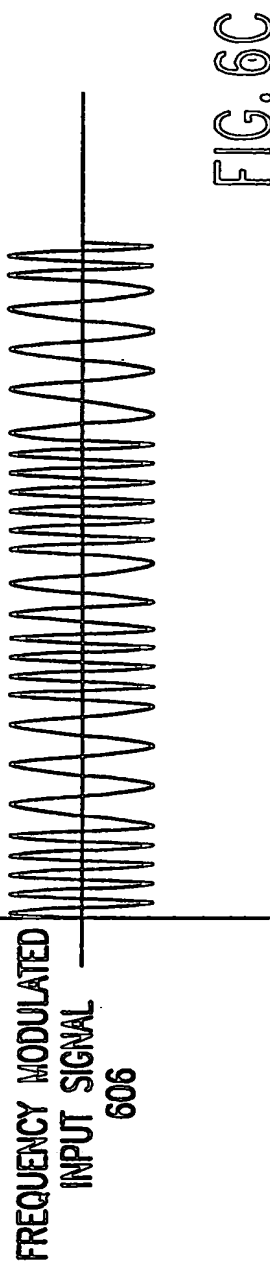
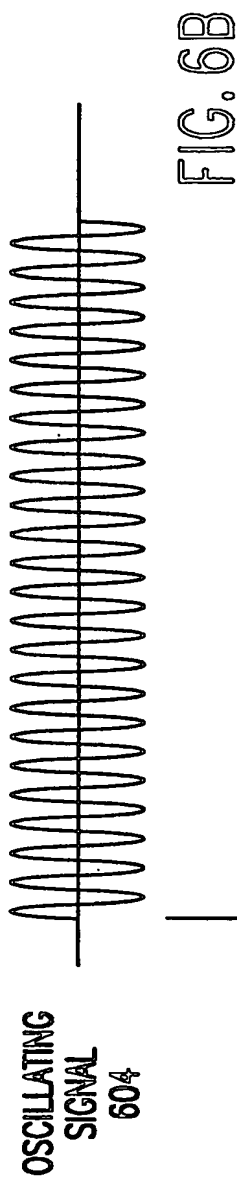
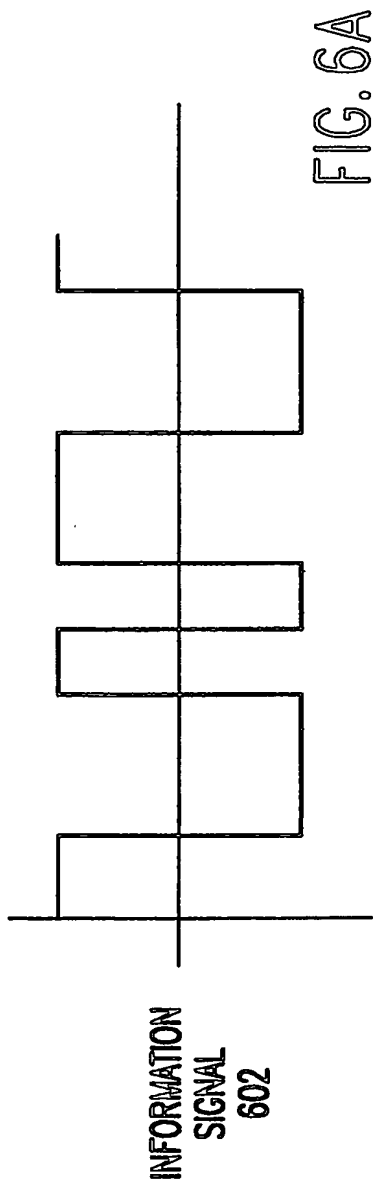
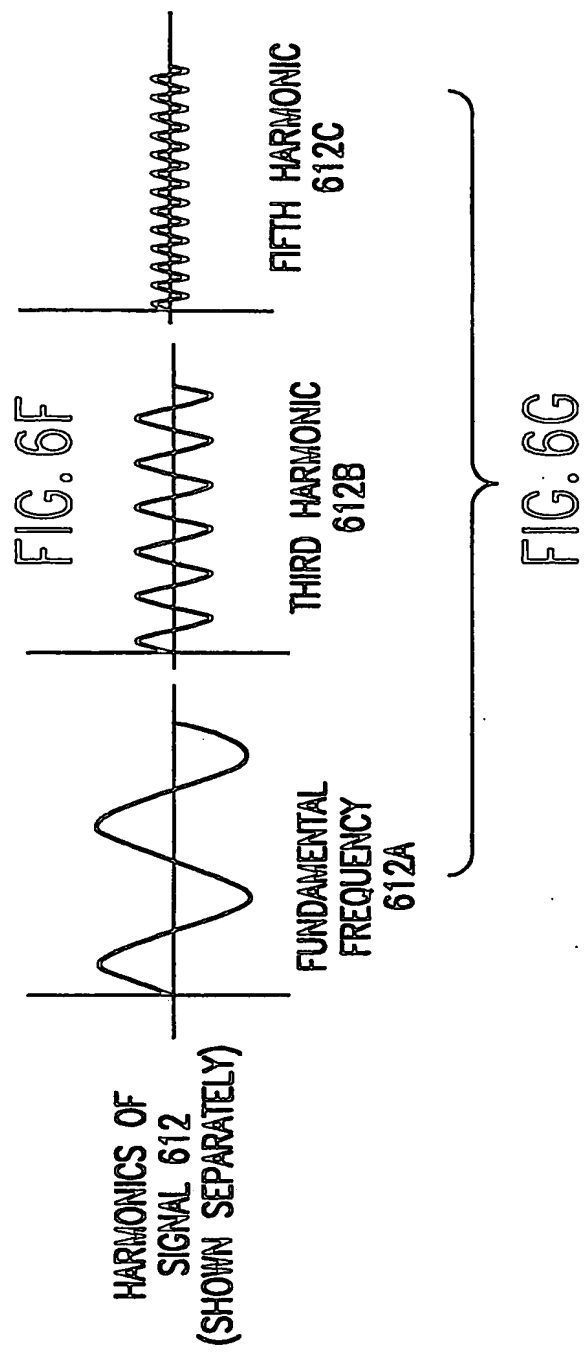
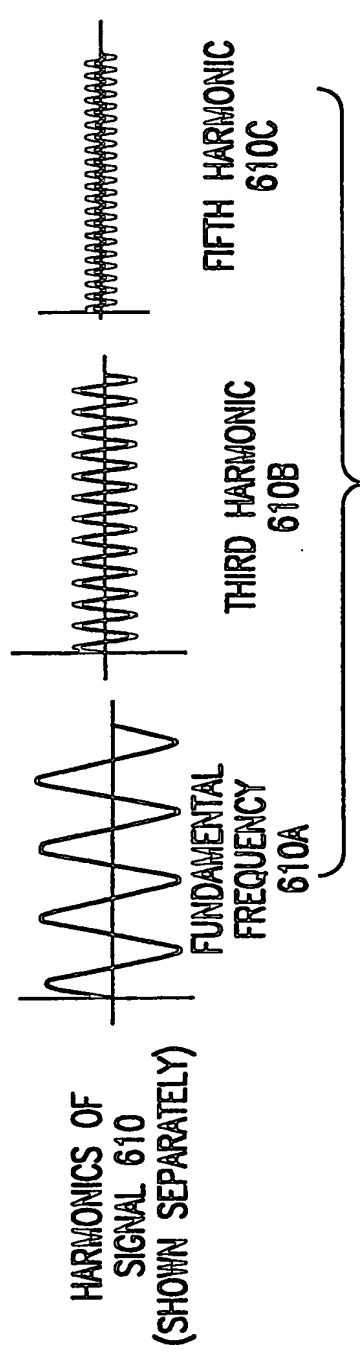
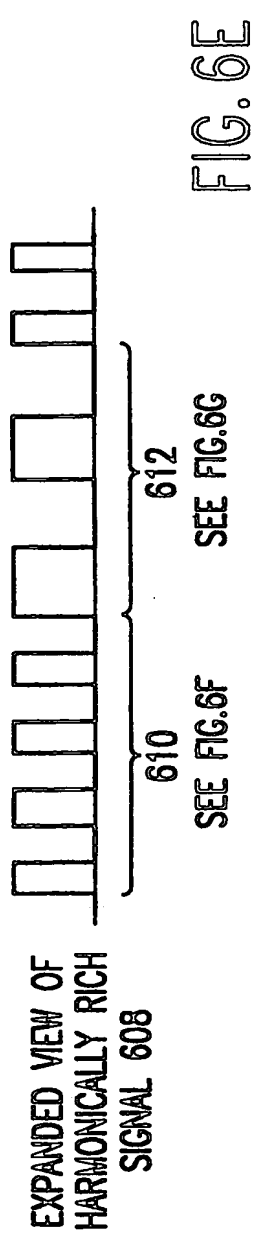
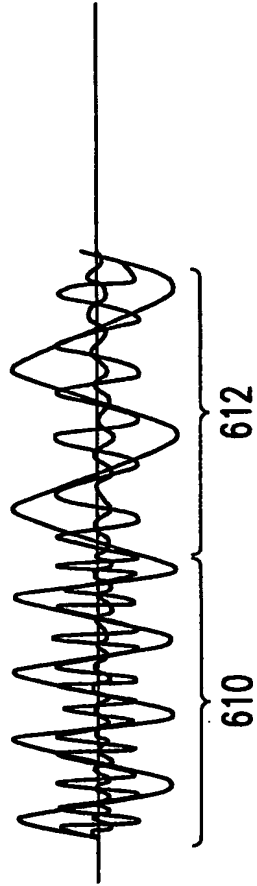


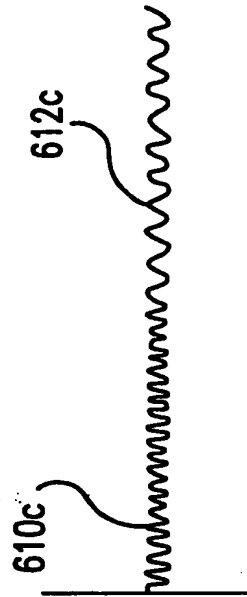
FIG. 5







HARMONICS OF
 SIGNALS 610 AND
 612
 (SHOWN SIMULTANEOUSLY
 BUT NOT SUMMED)



FILTERED
 OUTPUT
 SIGNAL
 614

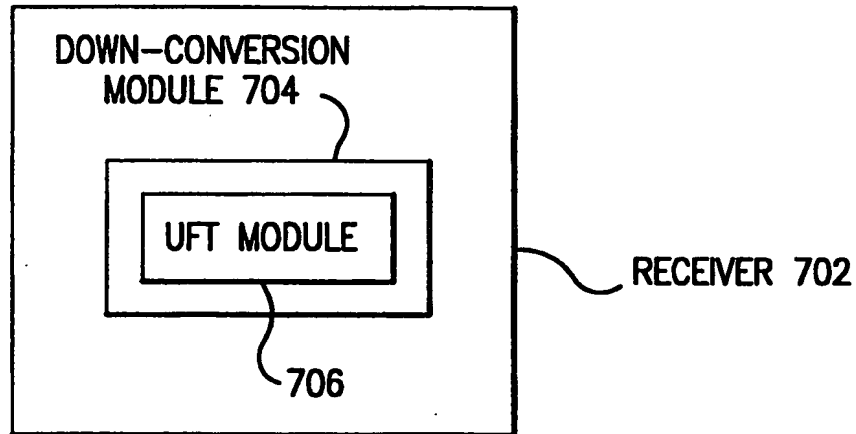


FIG. 7

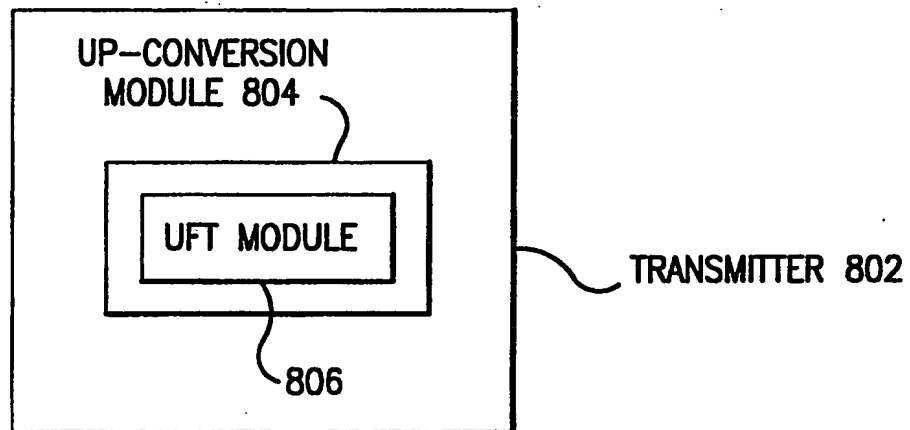


FIG. 8

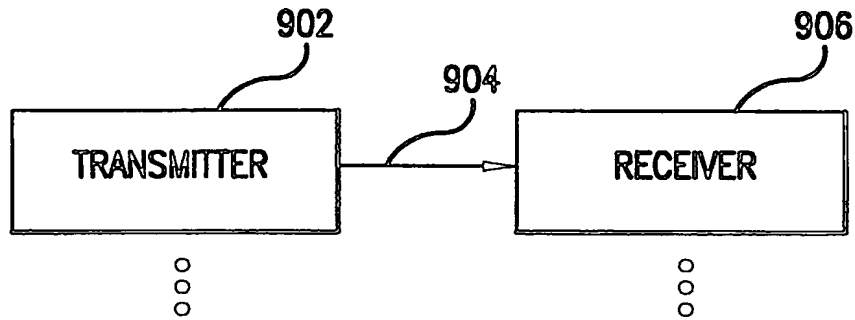


FIG. 9

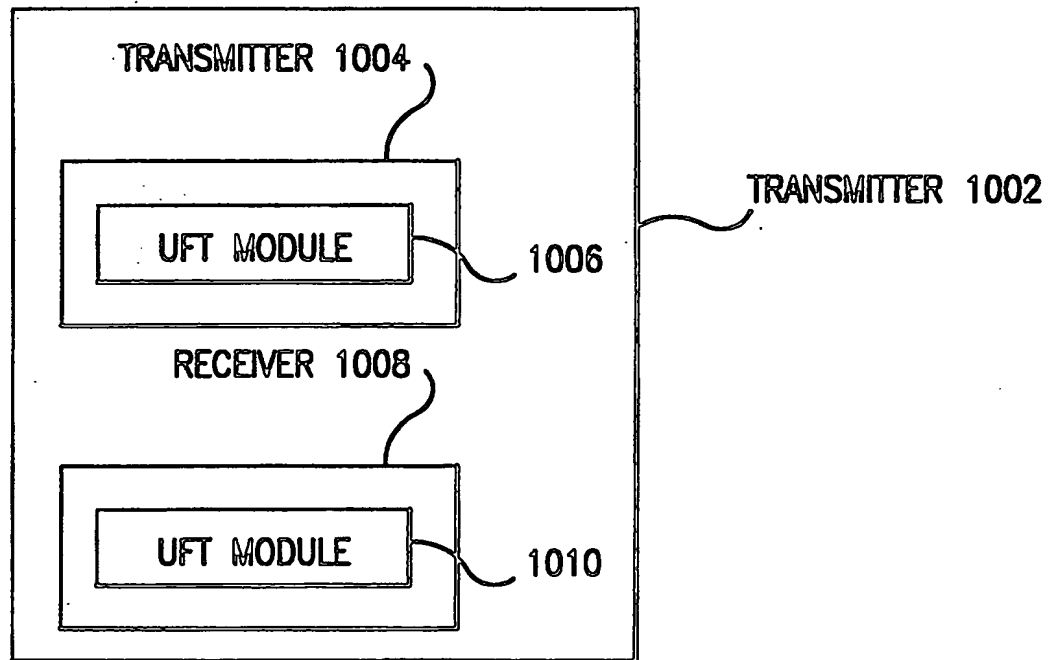


FIG. 10

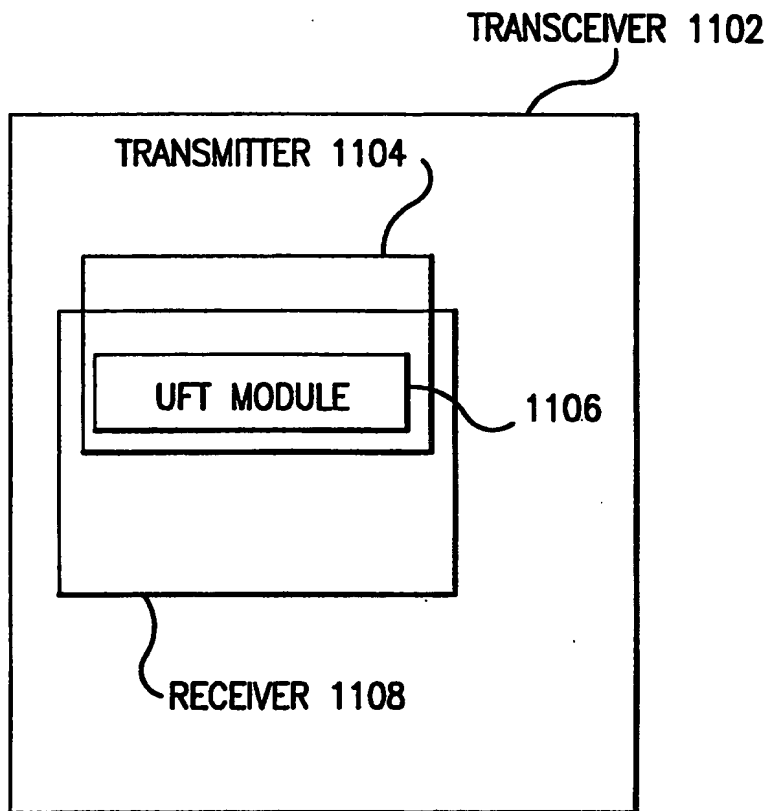


FIG. 11

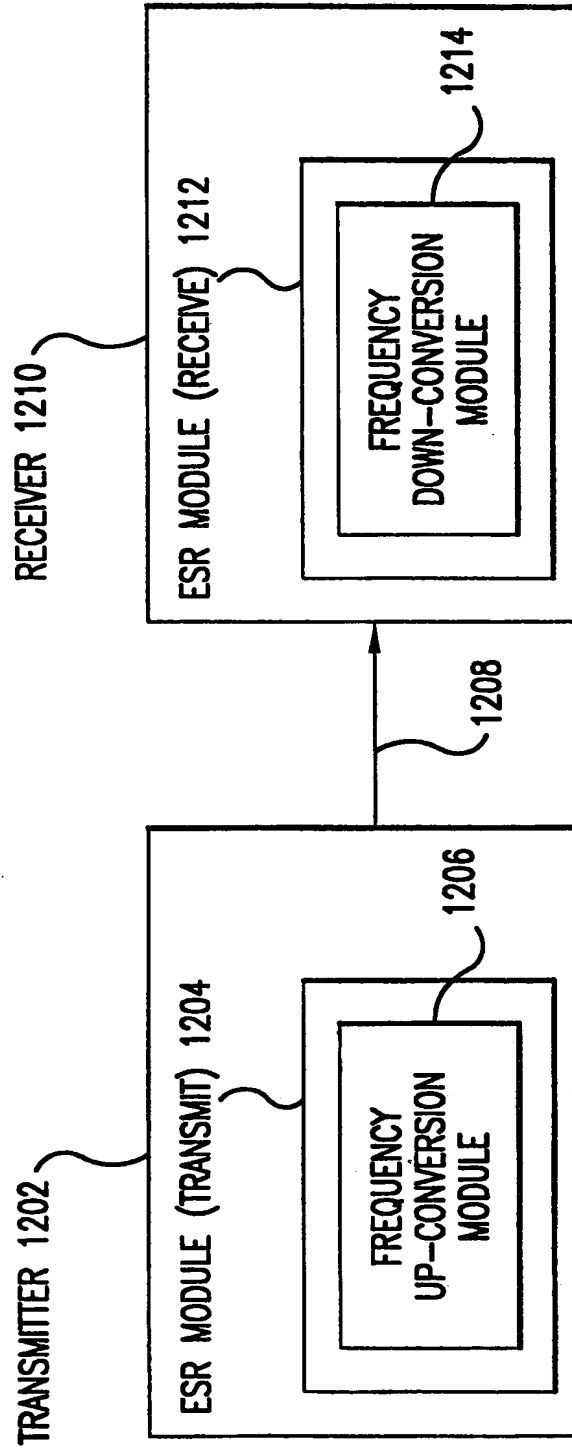


FIG. 12

UNIFIED DOWN-CONVERTING
AND FILTERING (UDF) MODULE 1302

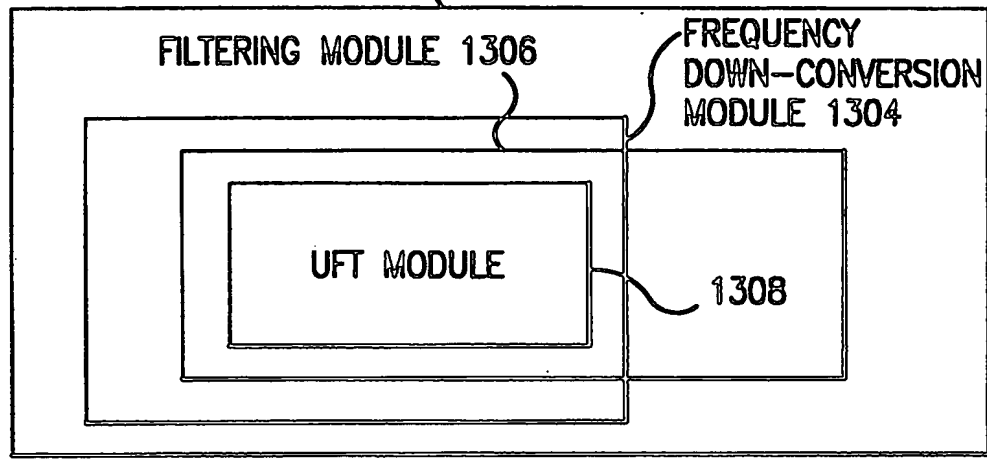


FIG. 13

RECEIVER 1402

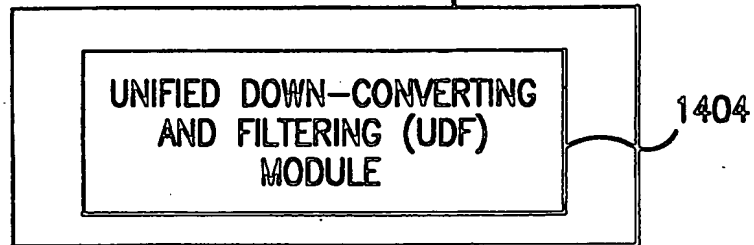


FIG. 14

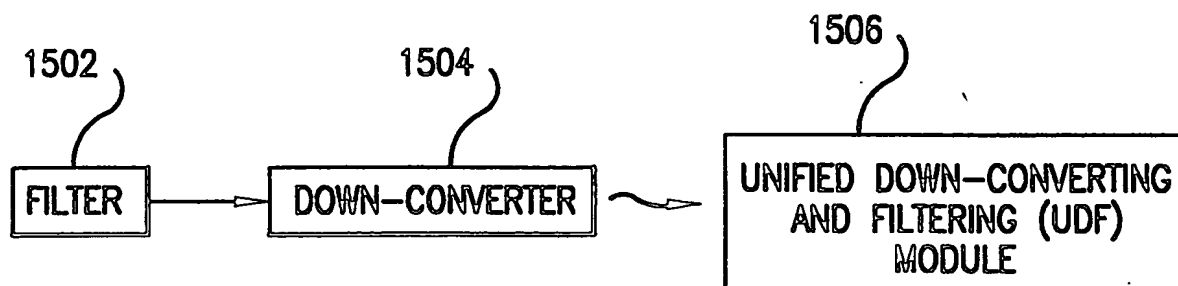


FIG. 15A

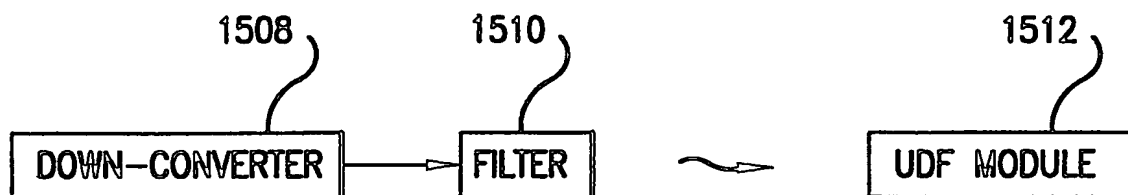


FIG. 15B

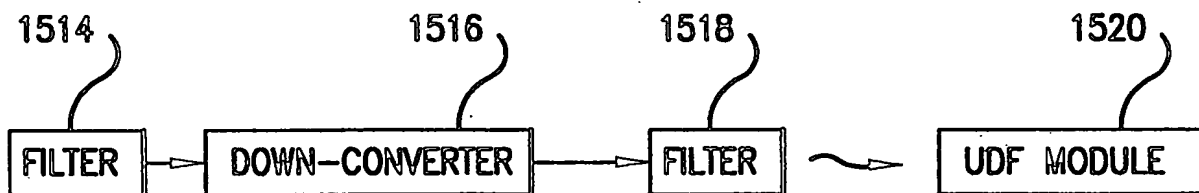


FIG. 15C

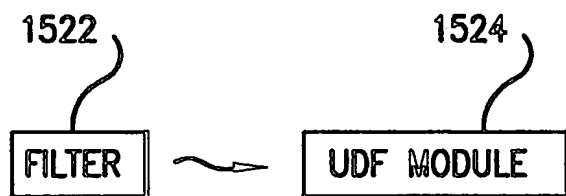


FIG. 15D

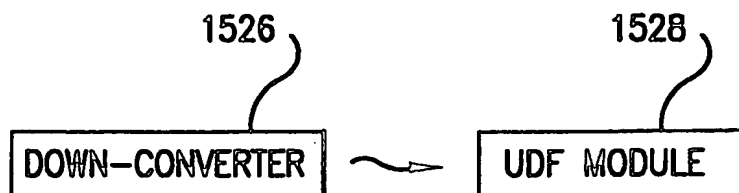


FIG. 15E



FIG. 15F

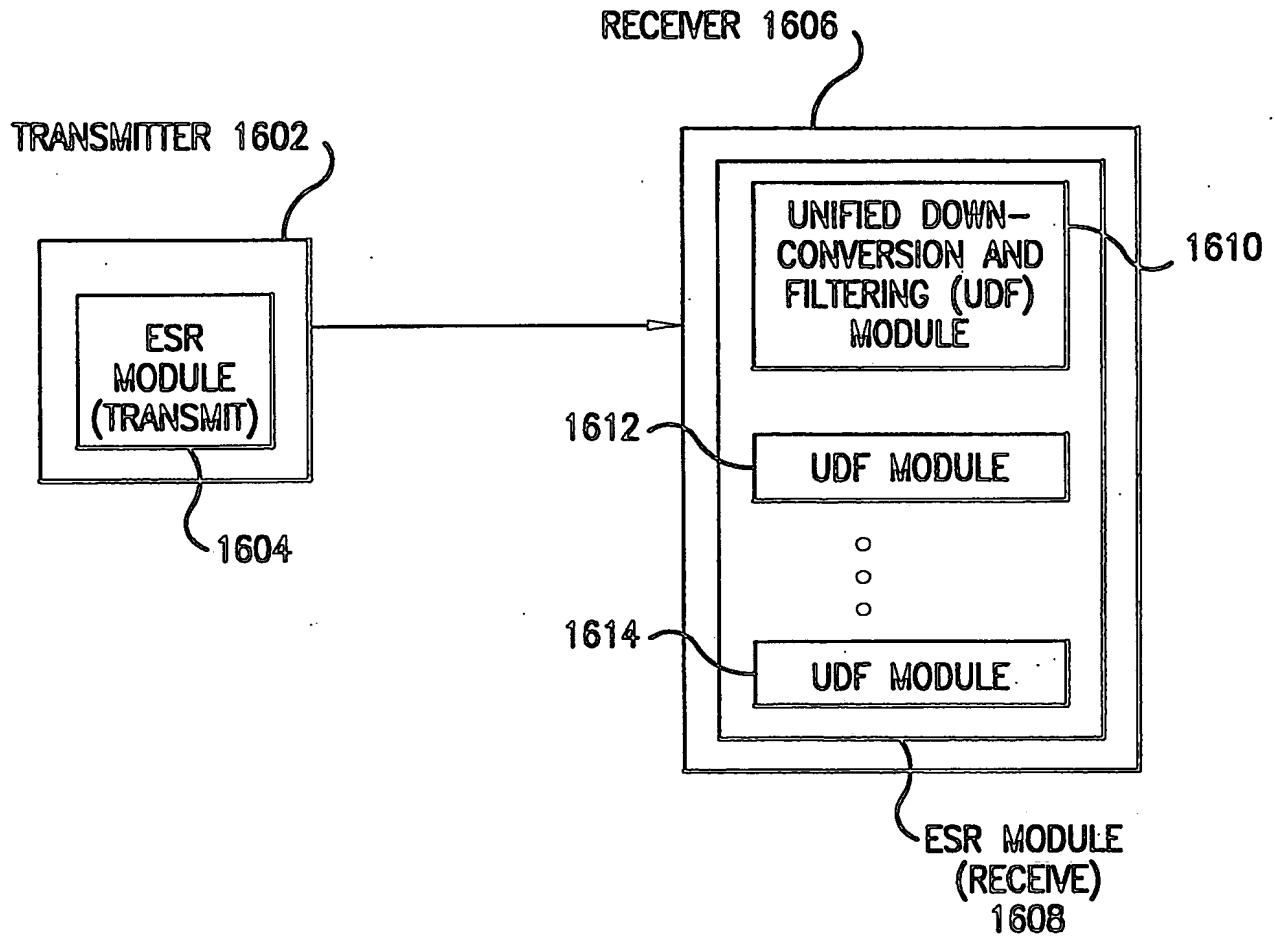


FIG. 16

UNIFIED DOWNCONVERTING AND
FILTERING (UDF) MODULE 1702

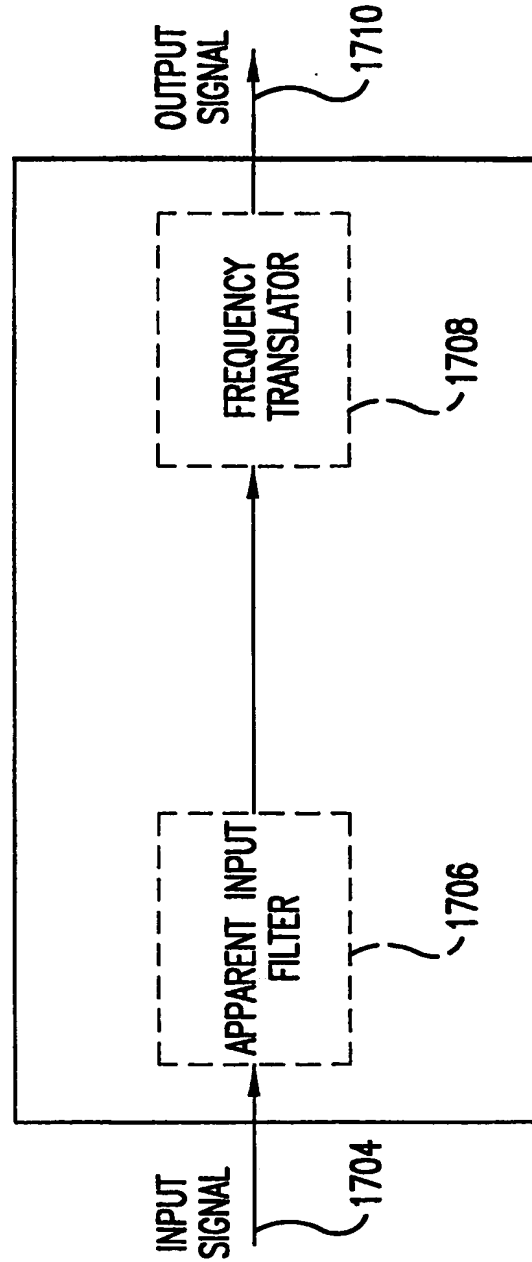


FIG. 17

TIME NODE	$t-1$ (RISING EDGE OF ϕ_1)	$t-1$ (RISING EDGE OF ϕ_2)	t (RISING EDGE OF ϕ_1)	t (RISING EDGE OF ϕ_2)	$t+1$ (RISING EDGE OF ϕ_1)
1902	V_{t-1} 1804	V_{t-1} 1808	V_t 1816	V_t 1826	V_{t+1} 1838
1904	—	V_{t-1} 1810	V_{t-1} 1818	V_t 1828	V_t 1840
1906	VO_{t-1} 1806	VO_{t-1} 1812	VO_t 1820	VO_t 1830	VO_{t+1} 1842
1908	—	VO_{t-1} 1814	VO_{t-1} 1822	VO_t 1832	VO_t 1844
1910	— 1807	—	VO_{t-1} 1824	VO_{t-1} 1834	VO_t 1846
1912	—	— 1815	—	VO_{t-1} 1836	VO_{t-1} 1848
1918	—	—	—	—	V_t 1850 $0.1 \cdot VO_t$ $0.8 \cdot VO_{t-1}$

FIG. 18

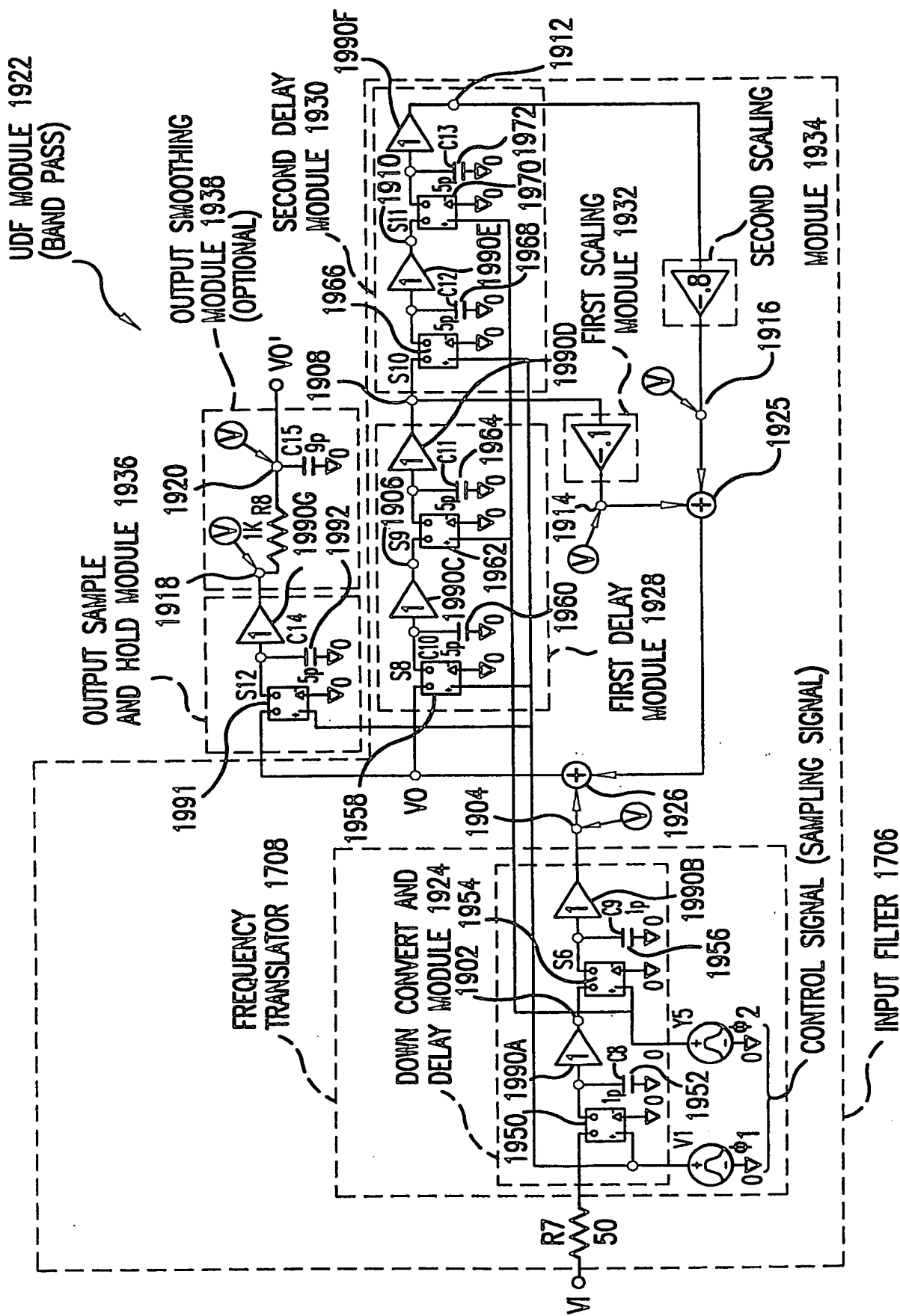


FIG. 19

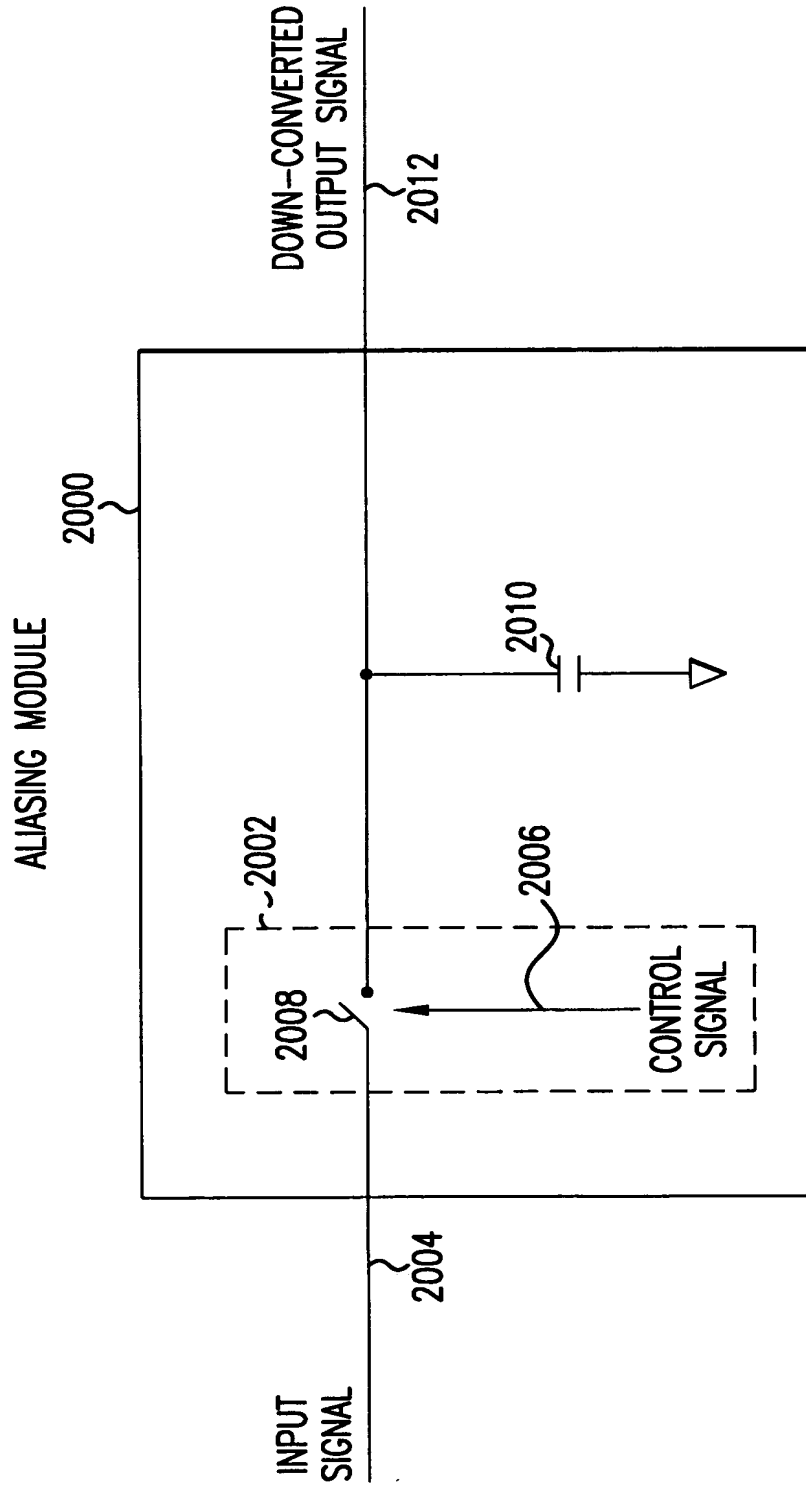


FIG.20A

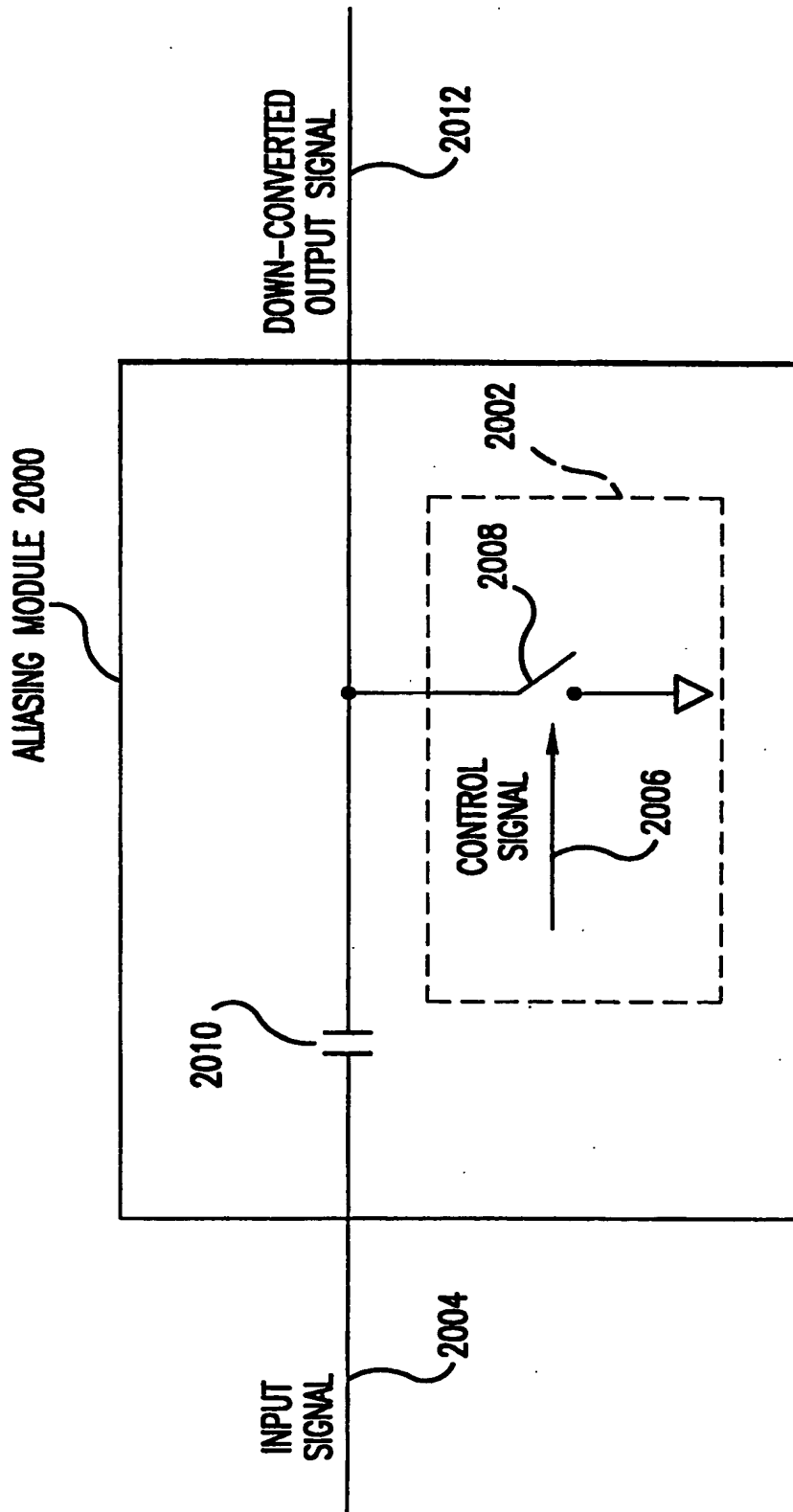


FIG. 20A-1

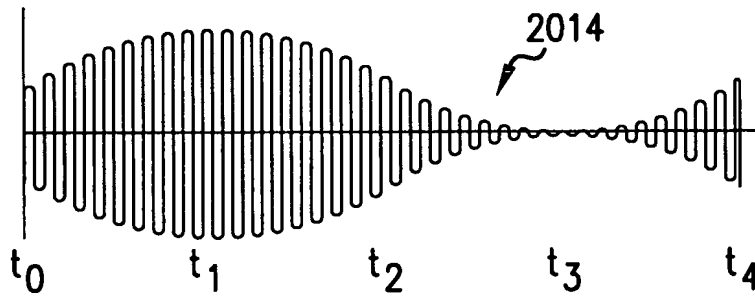


FIG. 20B

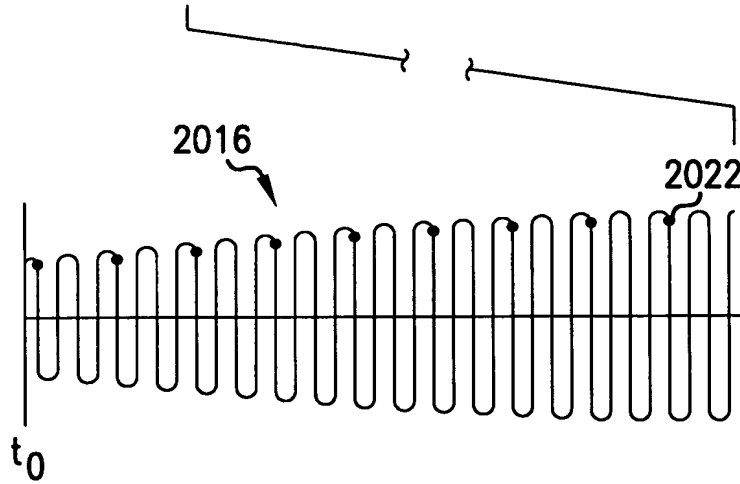


FIG. 20C

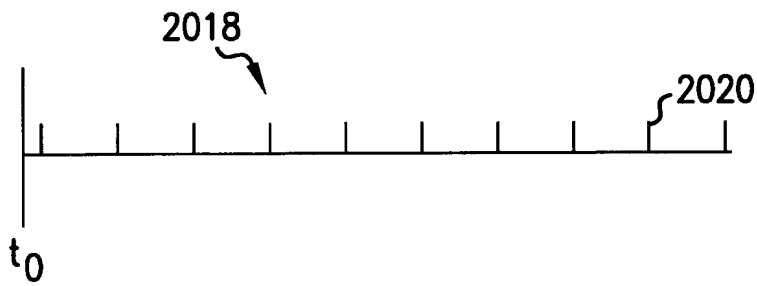


FIG. 20D

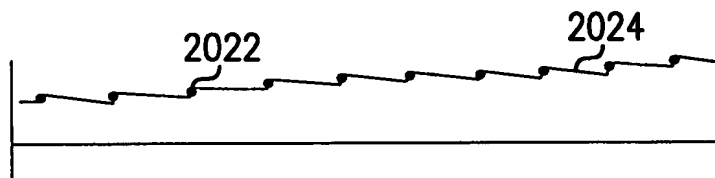


FIG. 20E

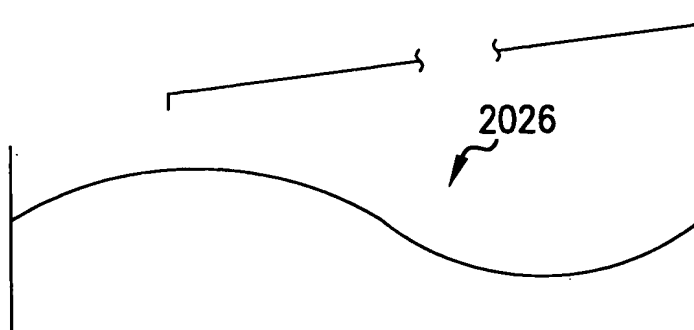


FIG. 20F

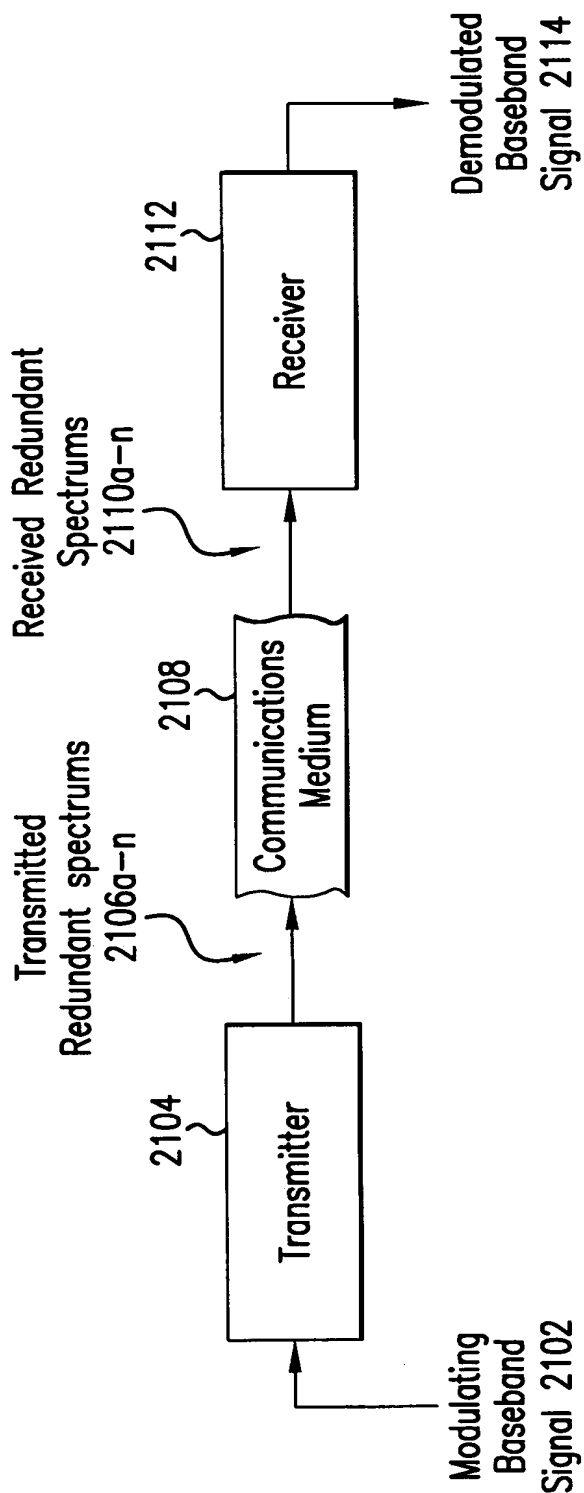


FIG. 21



FIG. 22B

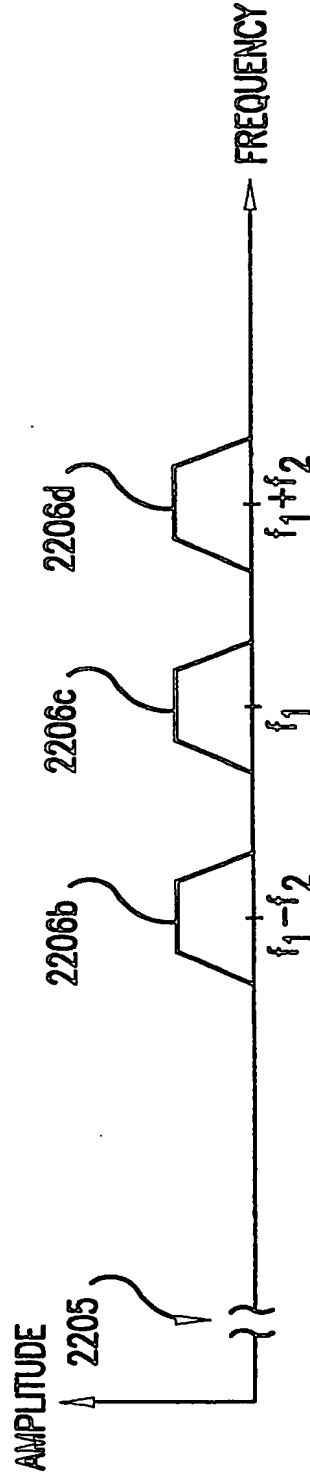


FIG. 22D

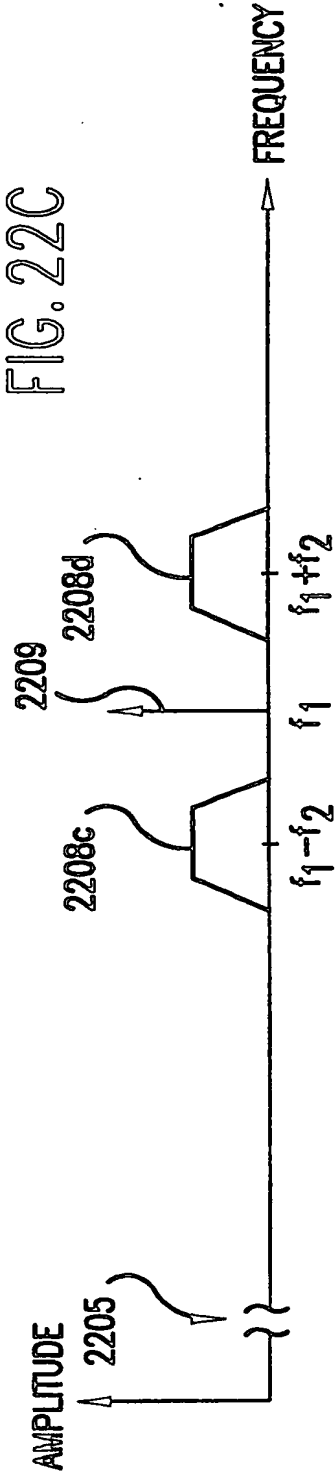


FIG. 22E

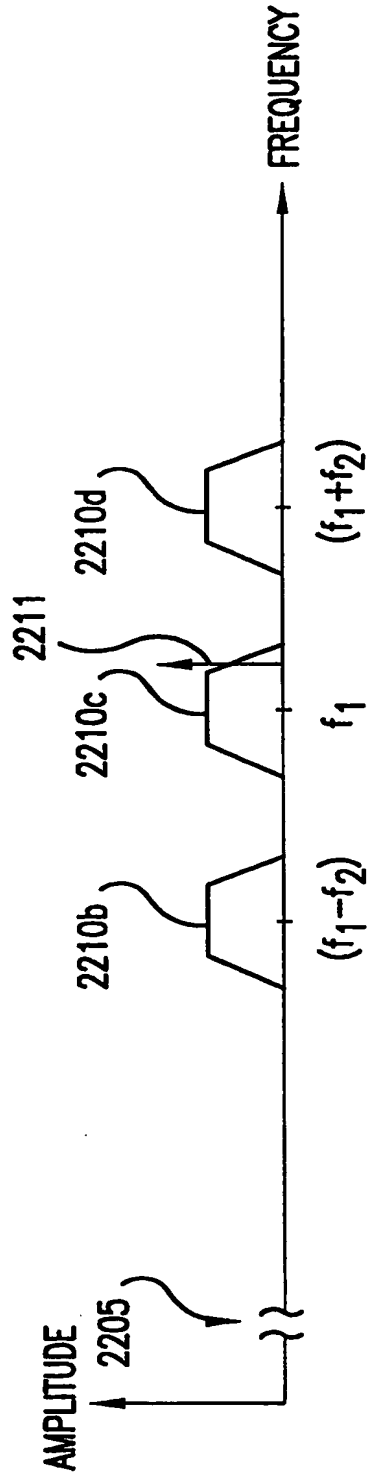


FIG. 22E

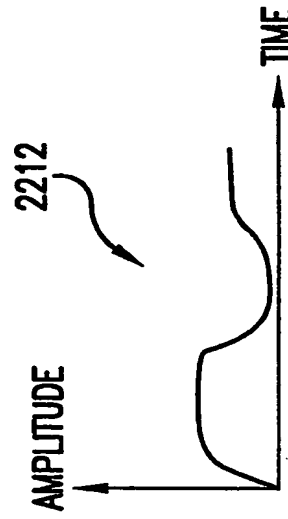


FIG. 22F

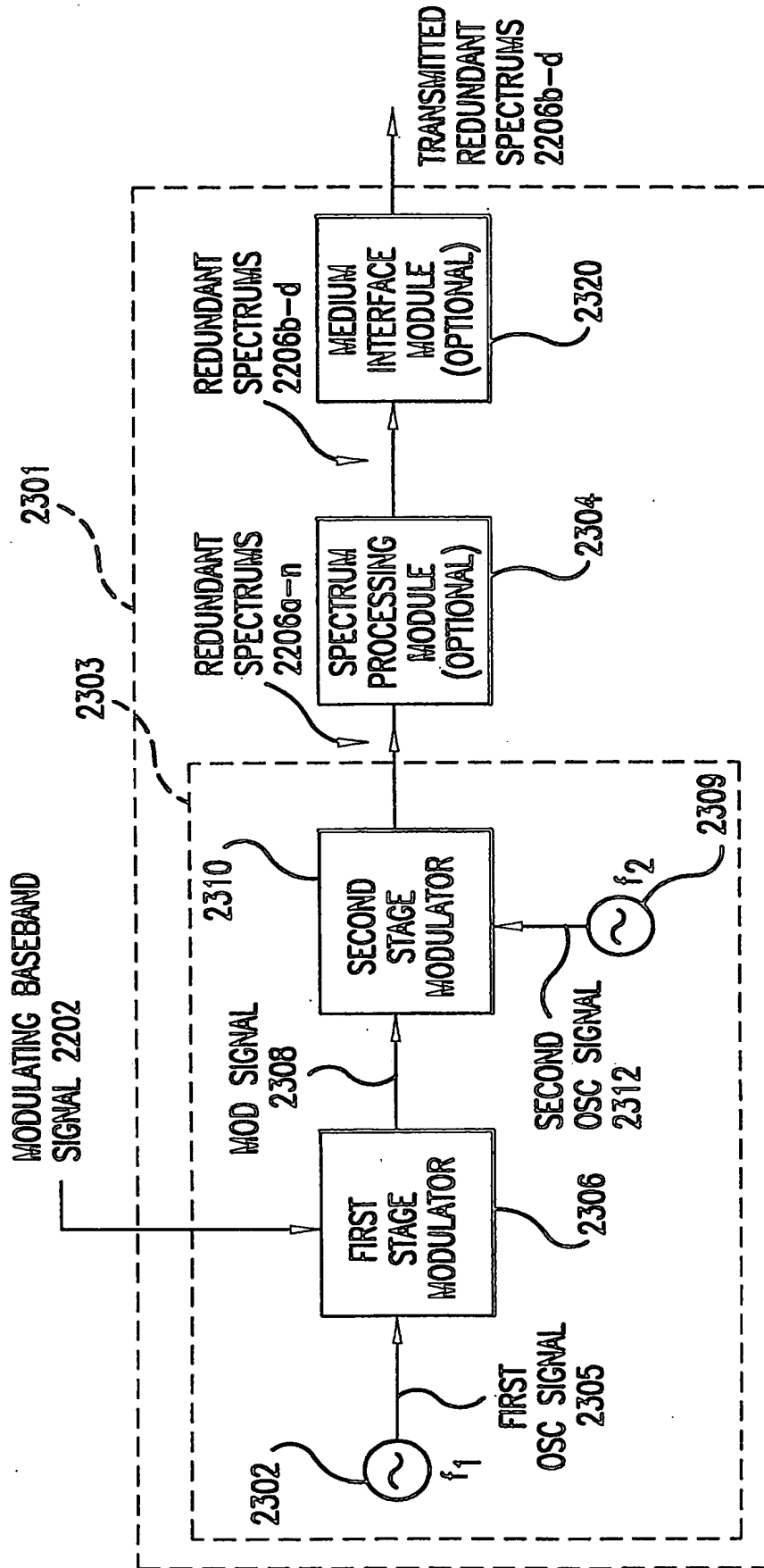


FIG. 23A

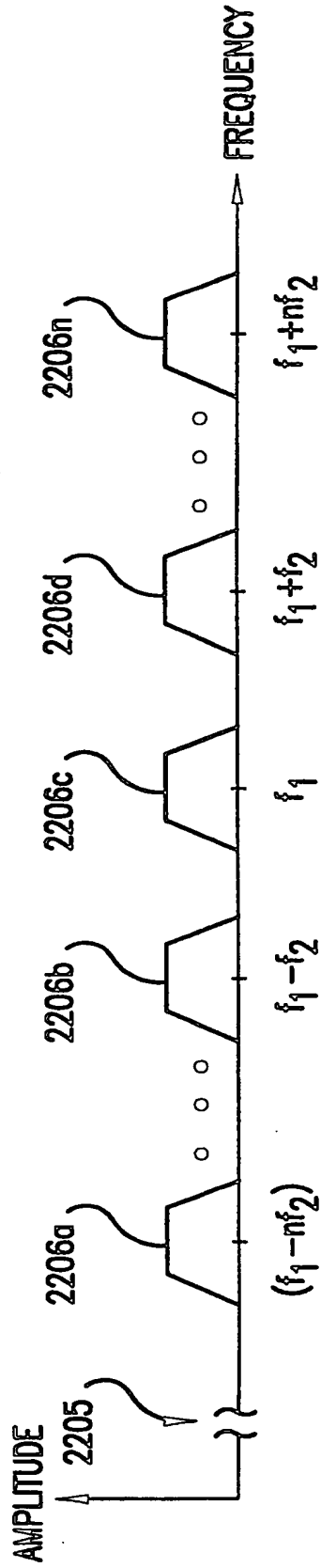


FIG. 23B

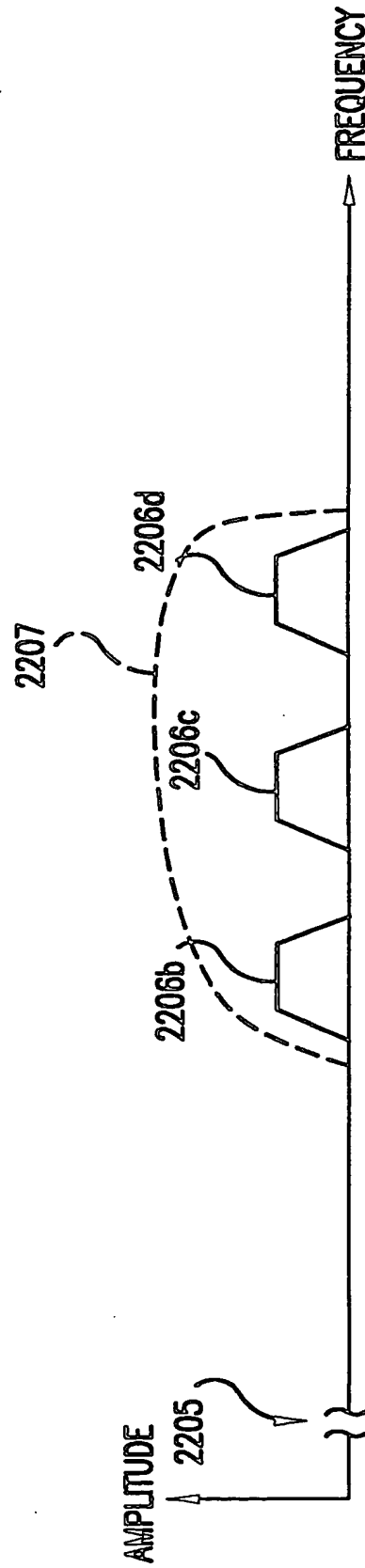


FIG. 23C

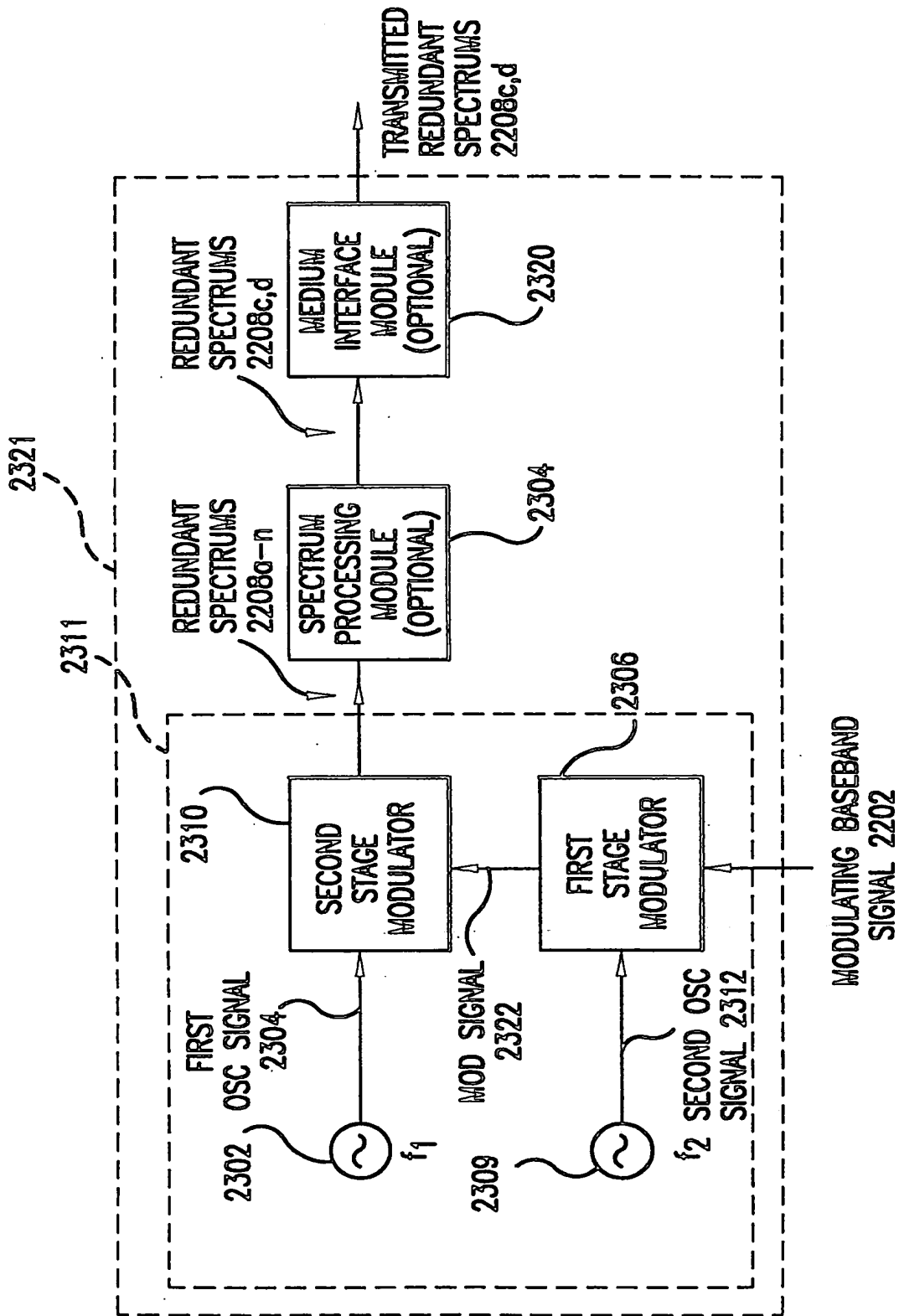


FIG. 23D

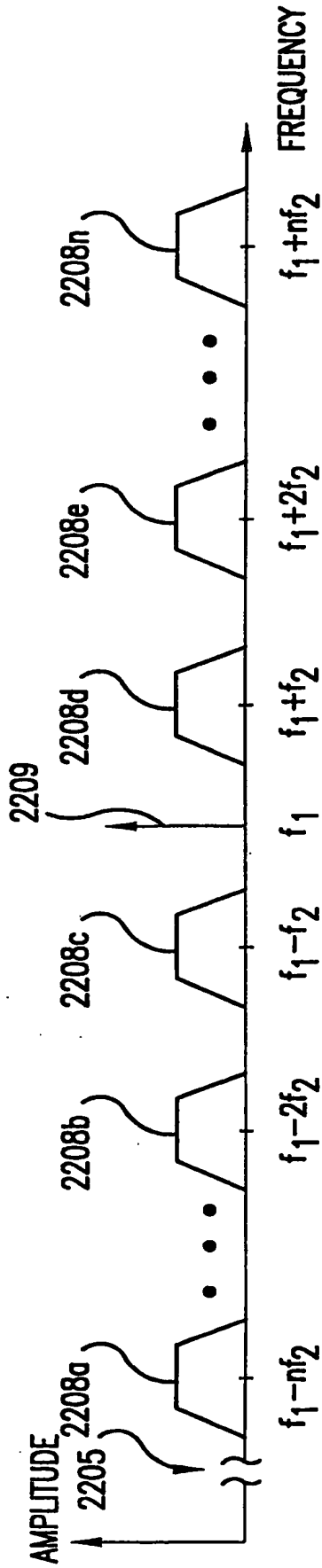


FIG. 23E

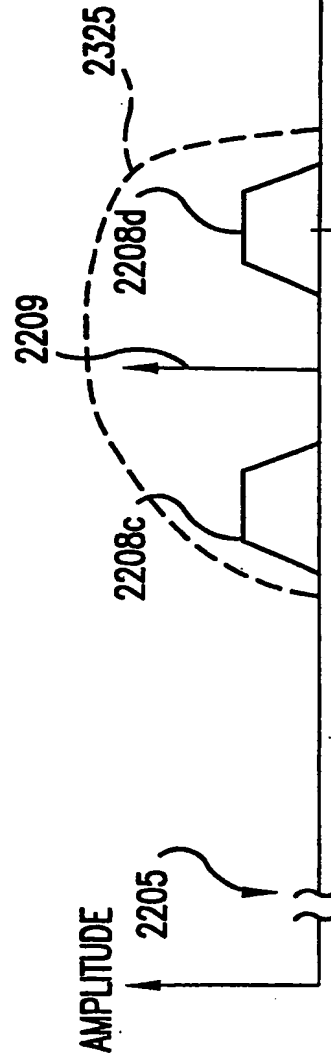


FIG. 23F

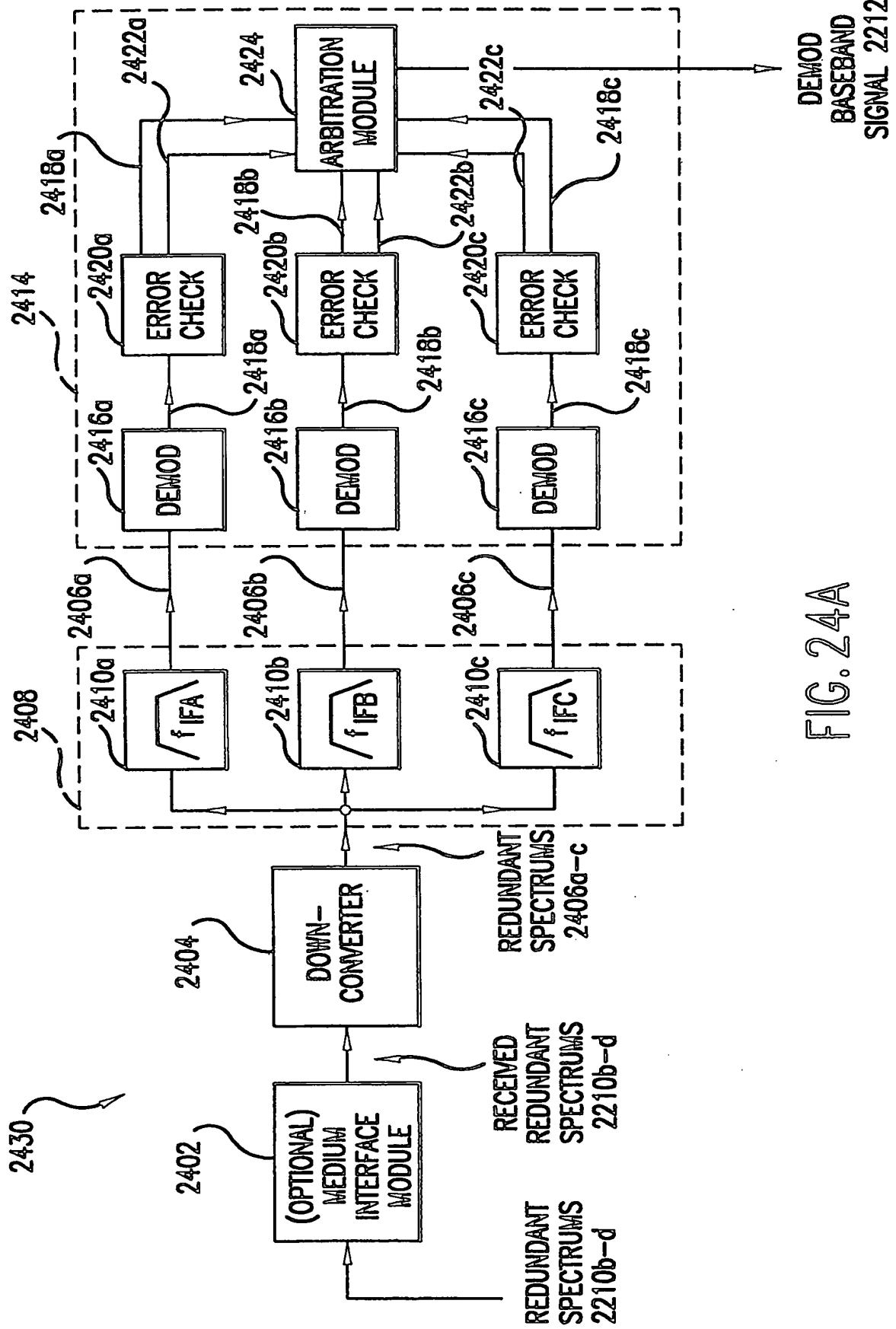


FIG. 24A

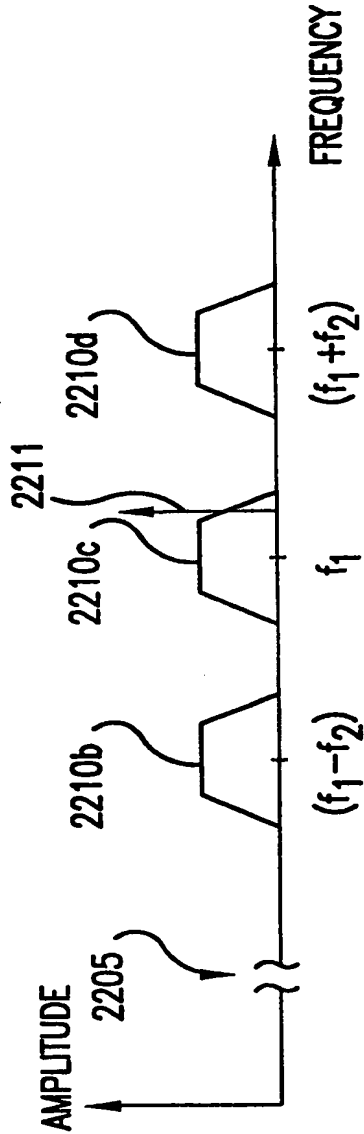


FIG. 24B

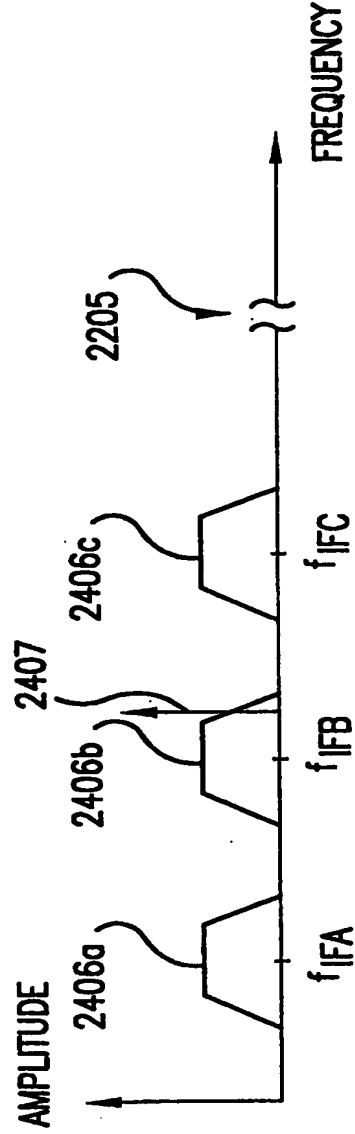
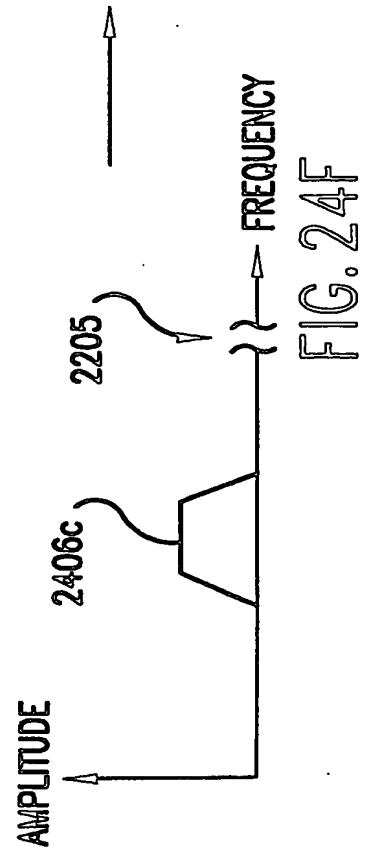
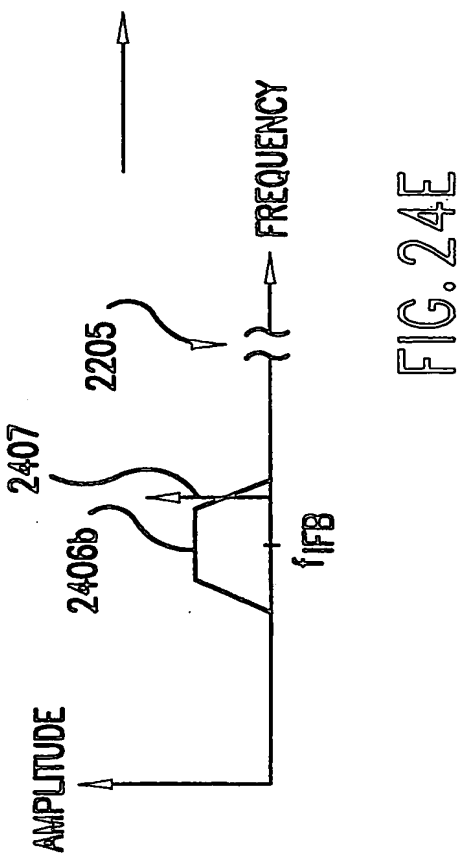
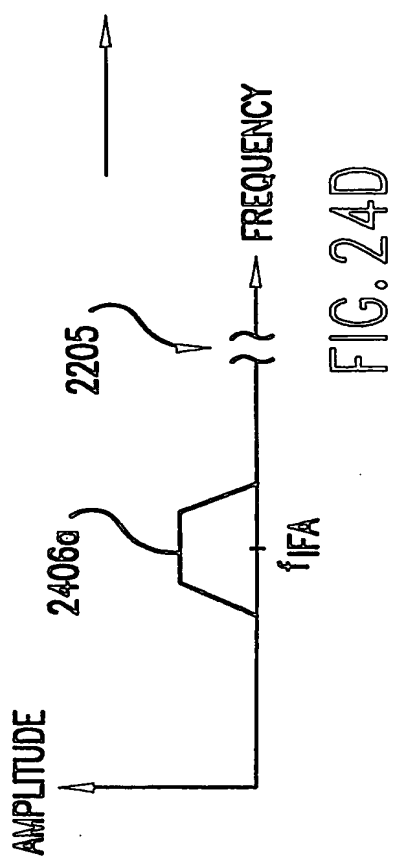
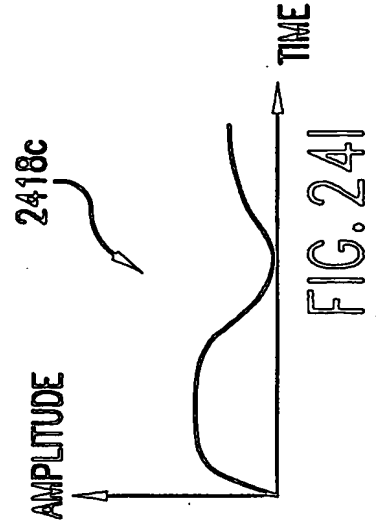
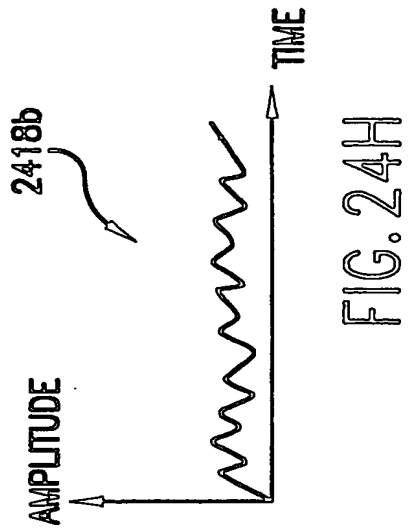
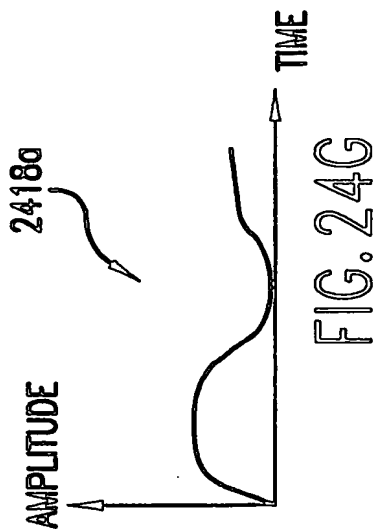


FIG. 24C



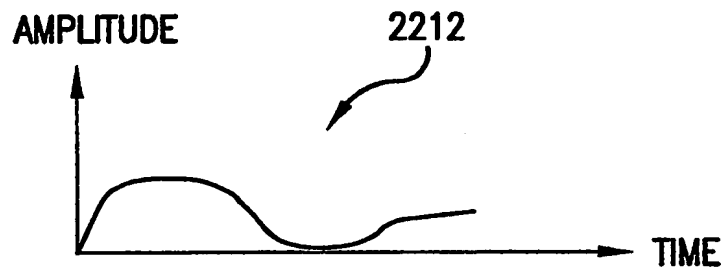


FIG. 24J

FIG. 25A

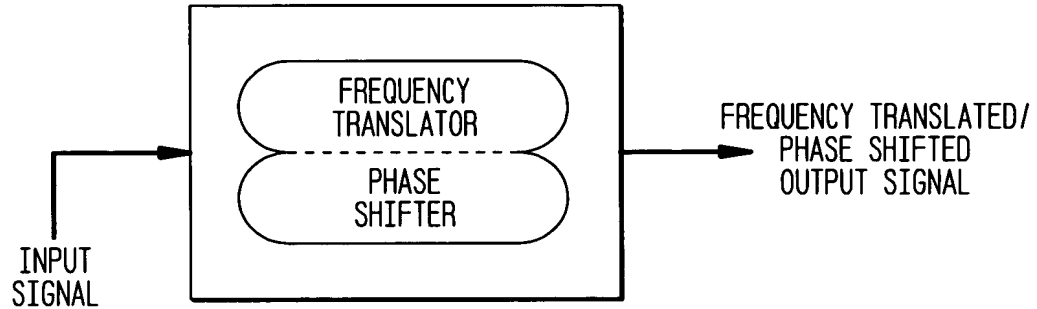


FIG. 25B

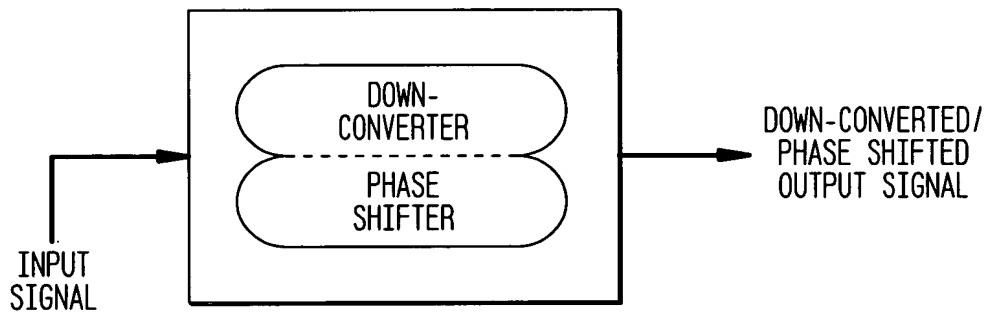


FIG. 25C

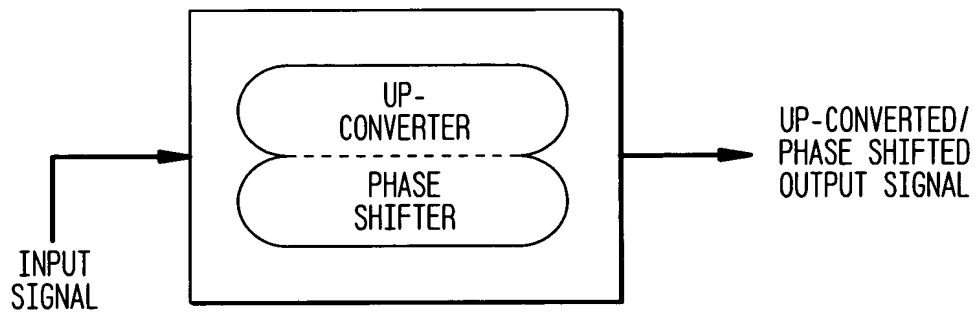


FIG. 25D

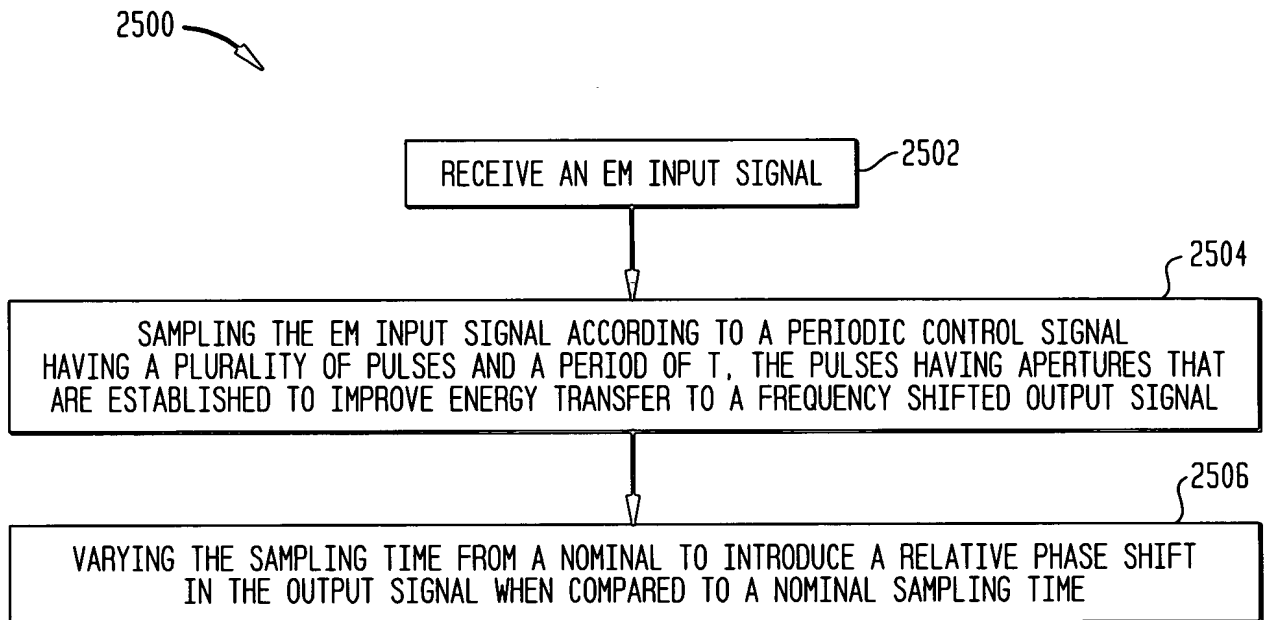


FIG. 25E

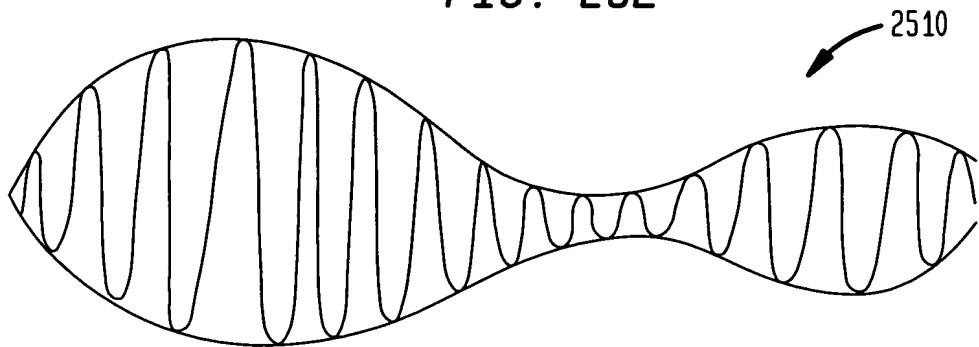


FIG. 25F

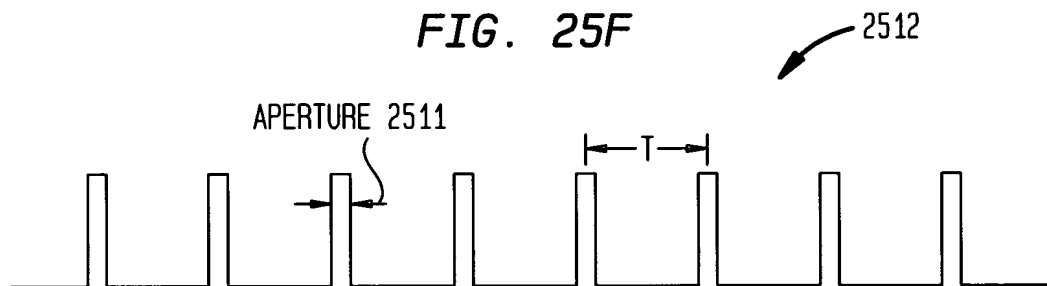


FIG. 25G

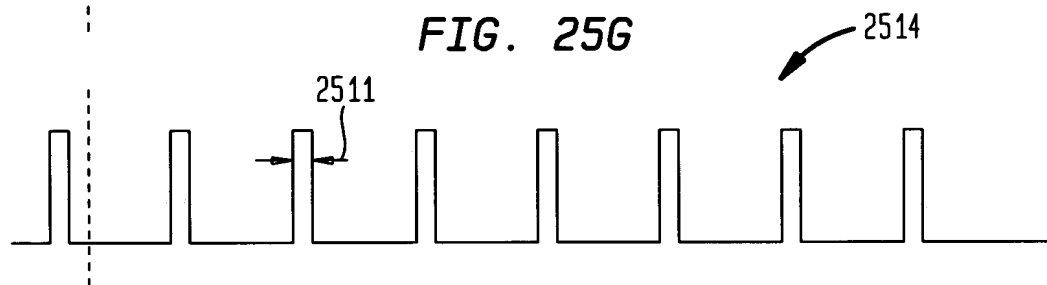


FIG. 25H

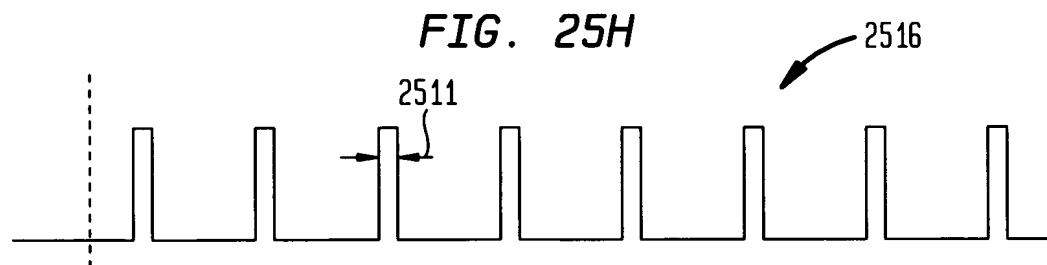


FIG. 25I

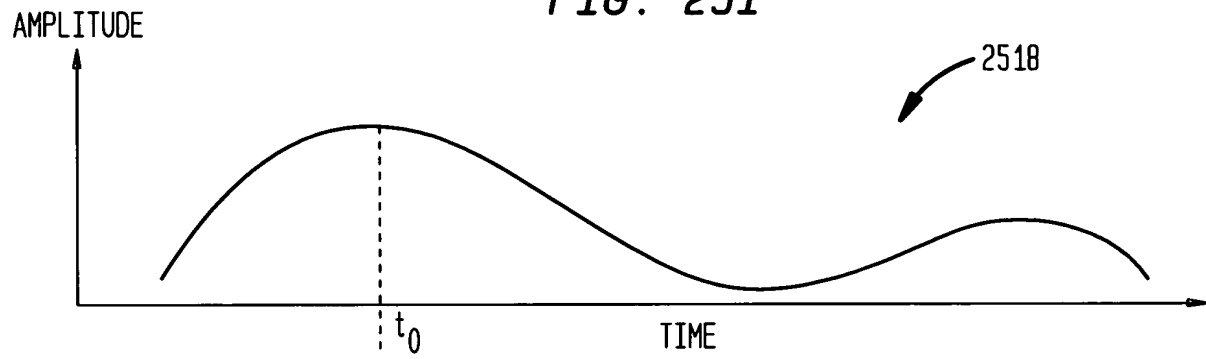


FIG. 25J

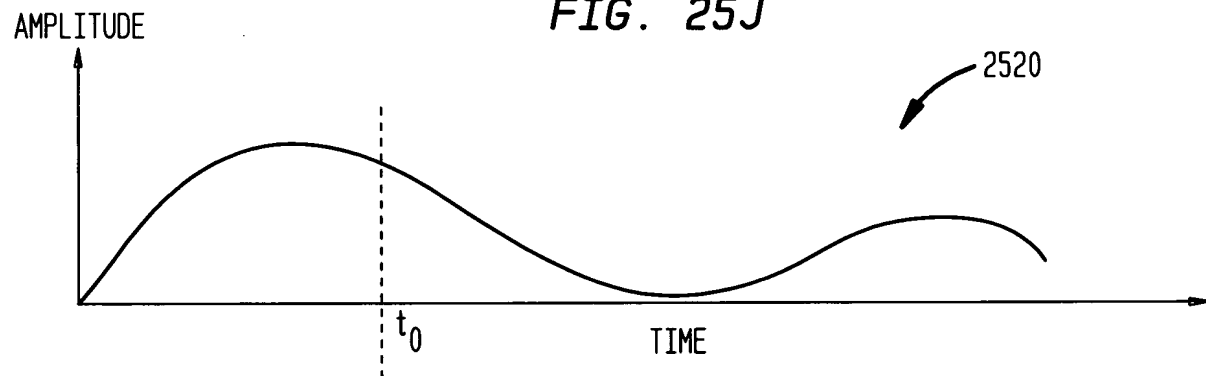


FIG. 25K

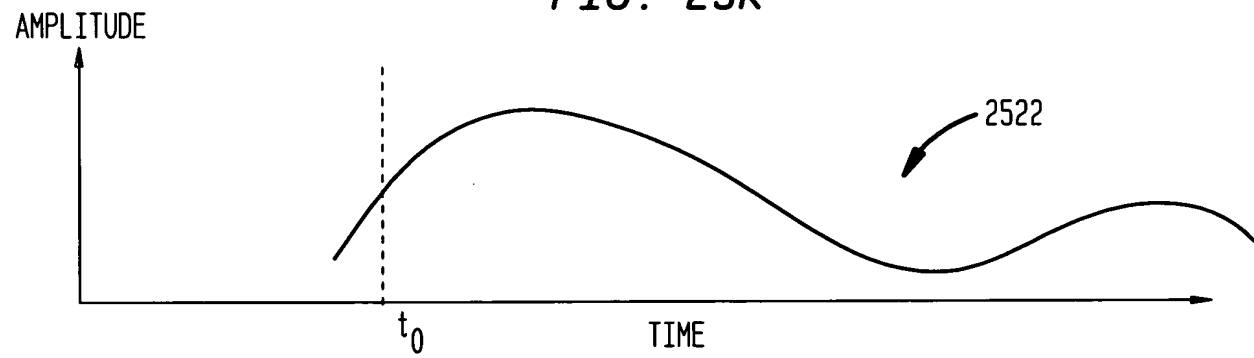
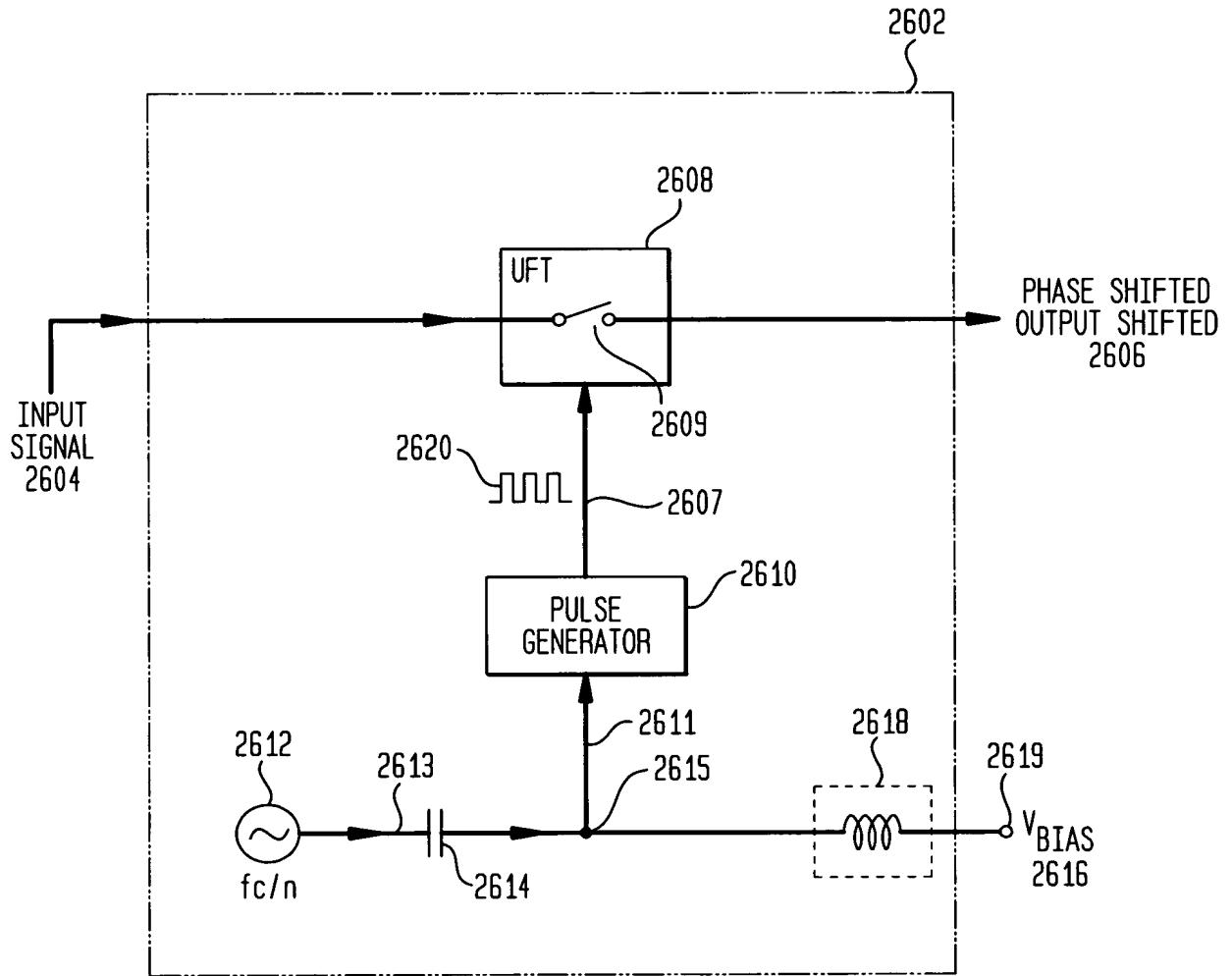
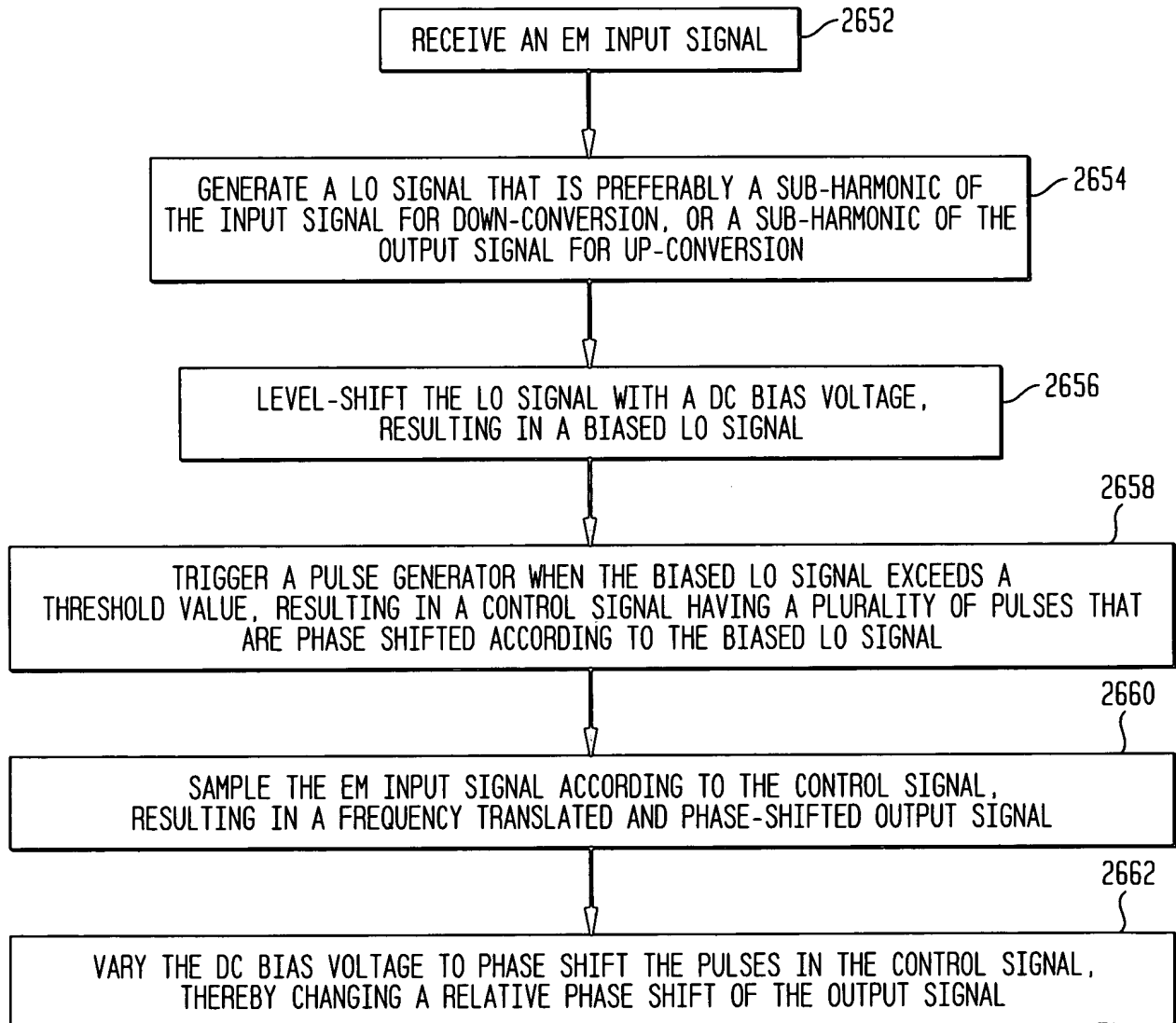


FIG. 26A



2650

FIG. 26B



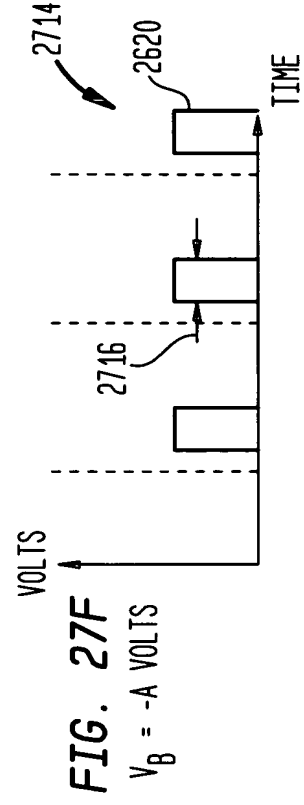
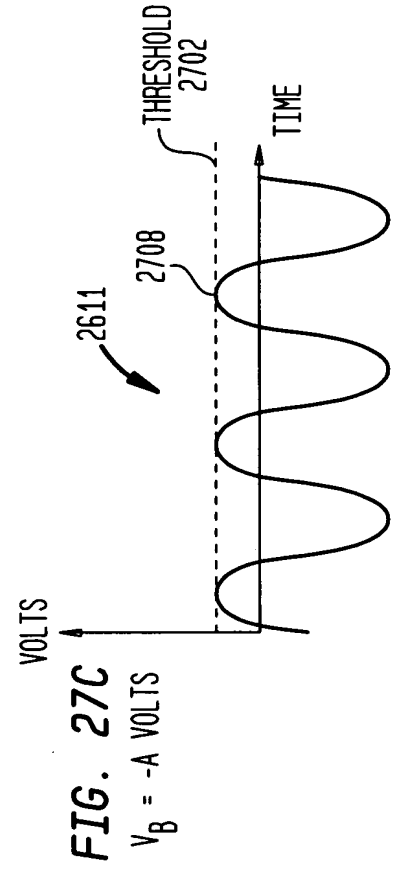
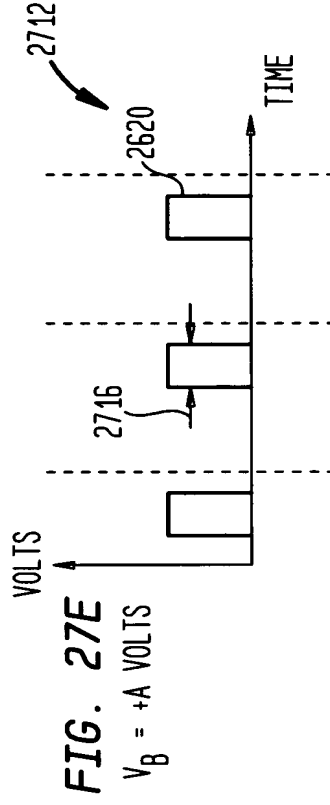
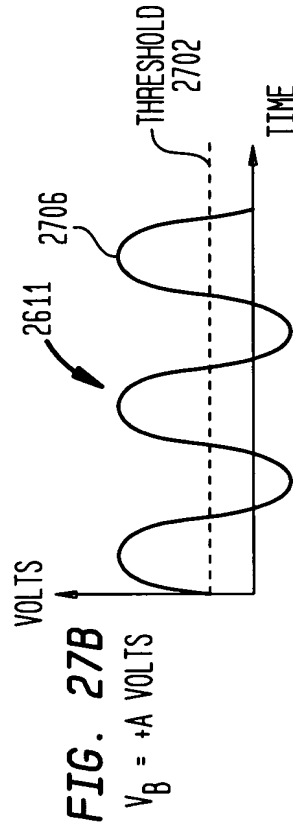
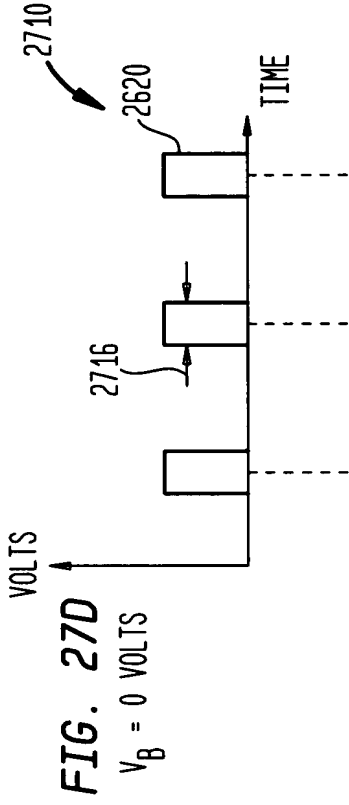
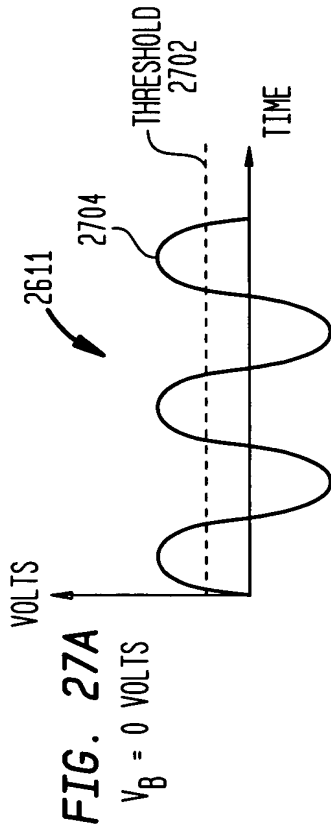


FIG. 28A

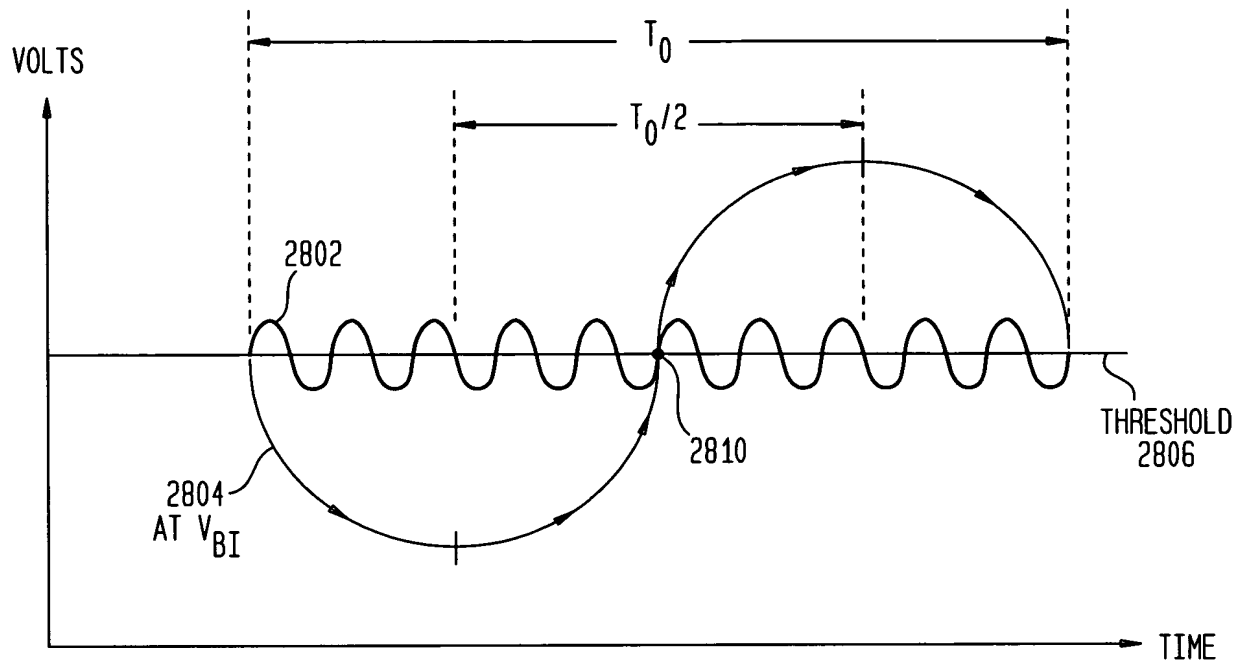


FIG. 28B

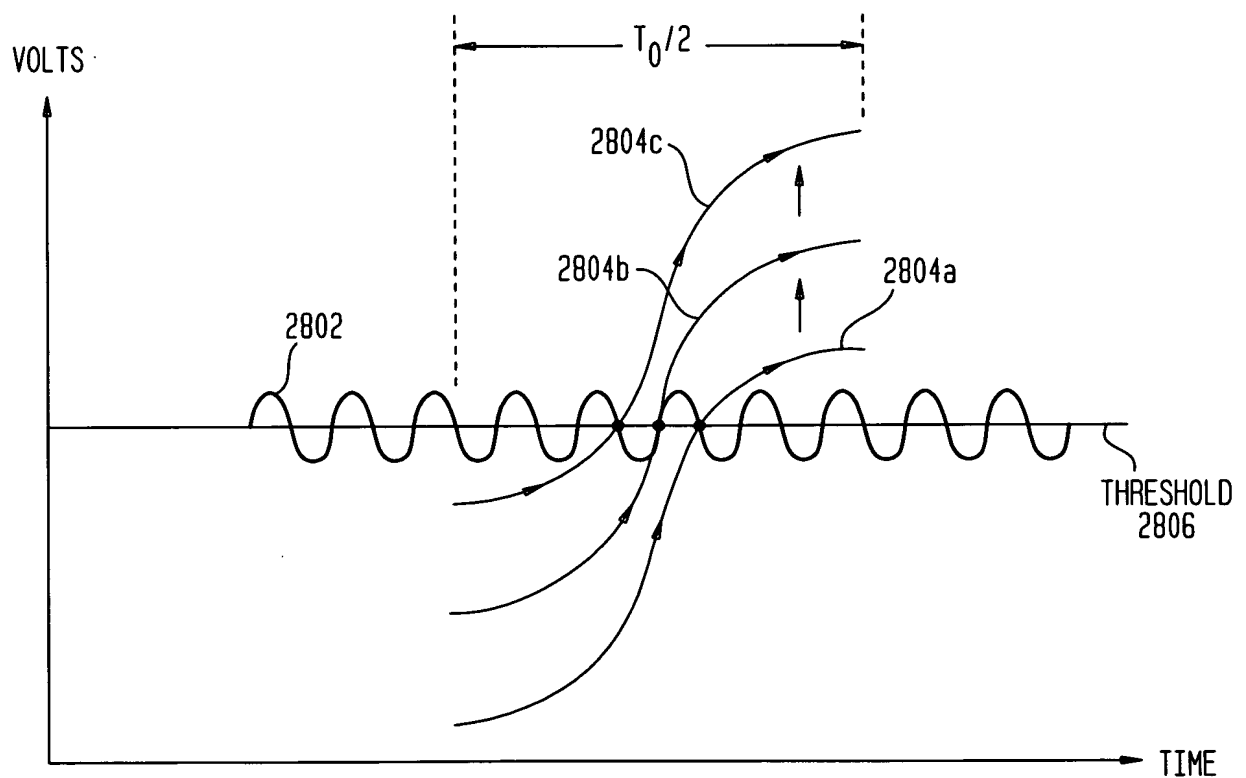


FIG. 29

Tek Stop: Single Seq 250kS/s

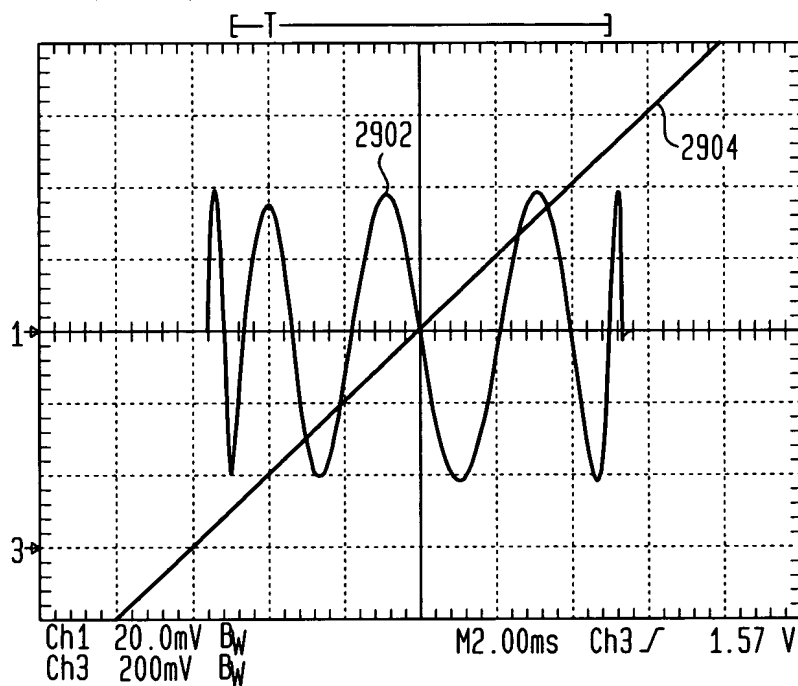


FIG. 30A

LO AMPLITUDE = 1.415 V_{p-p}

Tek stop: 25.0kS/s 122 Acqs

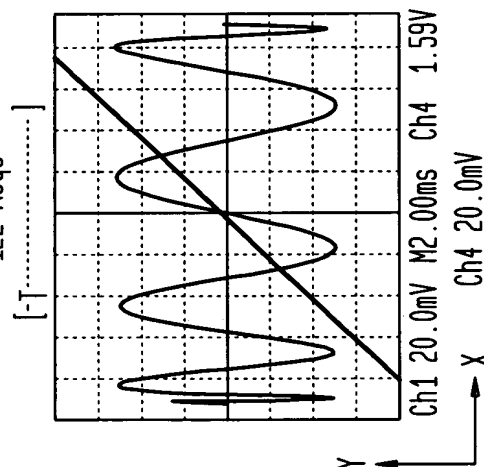


FIG. 30B

LO AMPLITUDE = 1.002 V_{p-p}

Tek stop: 25.0kS/s 51 Acqs

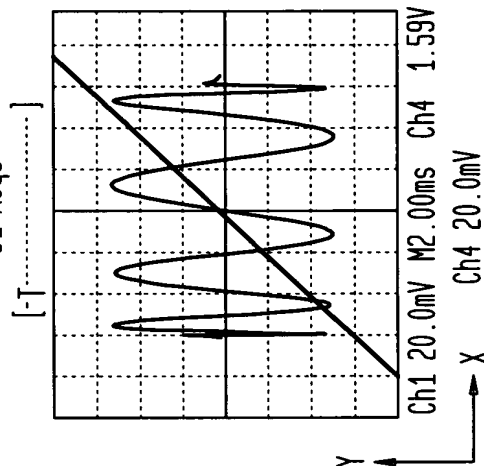


FIG. 30C

LO AMPLITUDE = 0.710 V_{p-p}

Tek stop: 25.0kS/s 149 Acqs

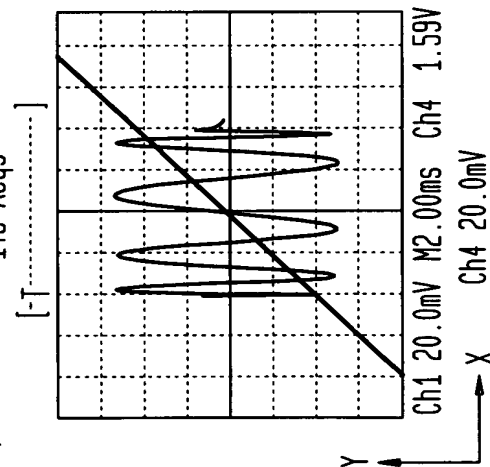


FIG. 30D

LO AMPLITUDE = 0.502 V_{p-p}

Tek stop: 25.0kS/s 118 Acqs

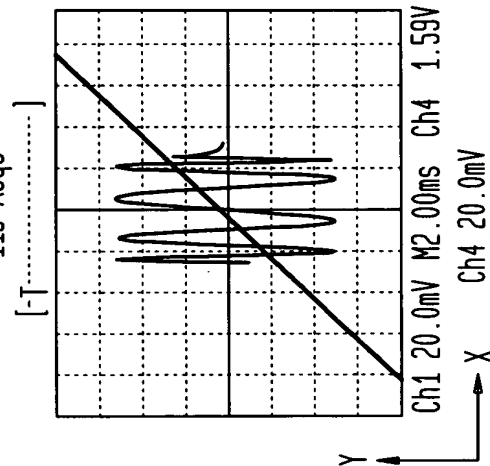


FIG. 31A

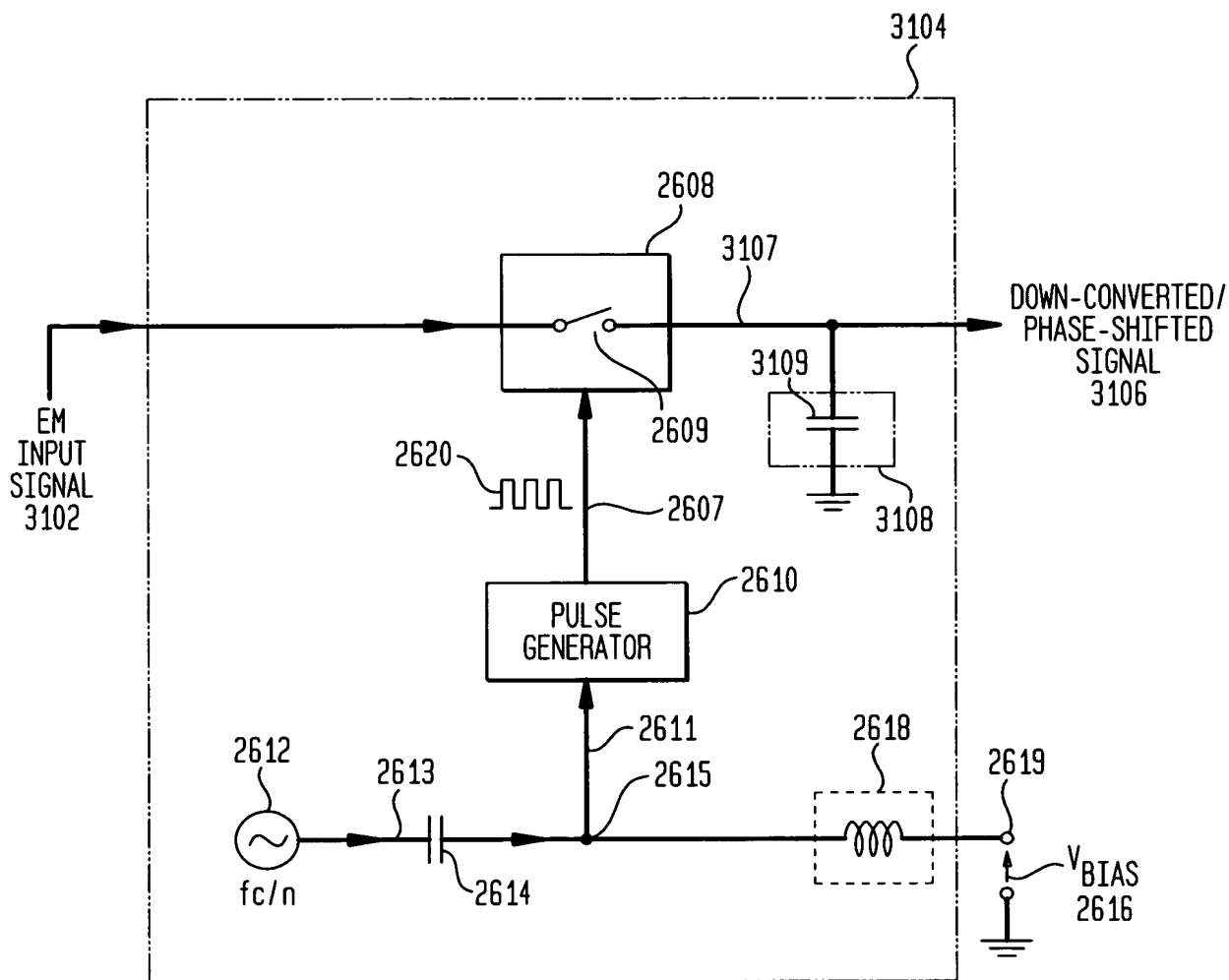


FIG. 31B

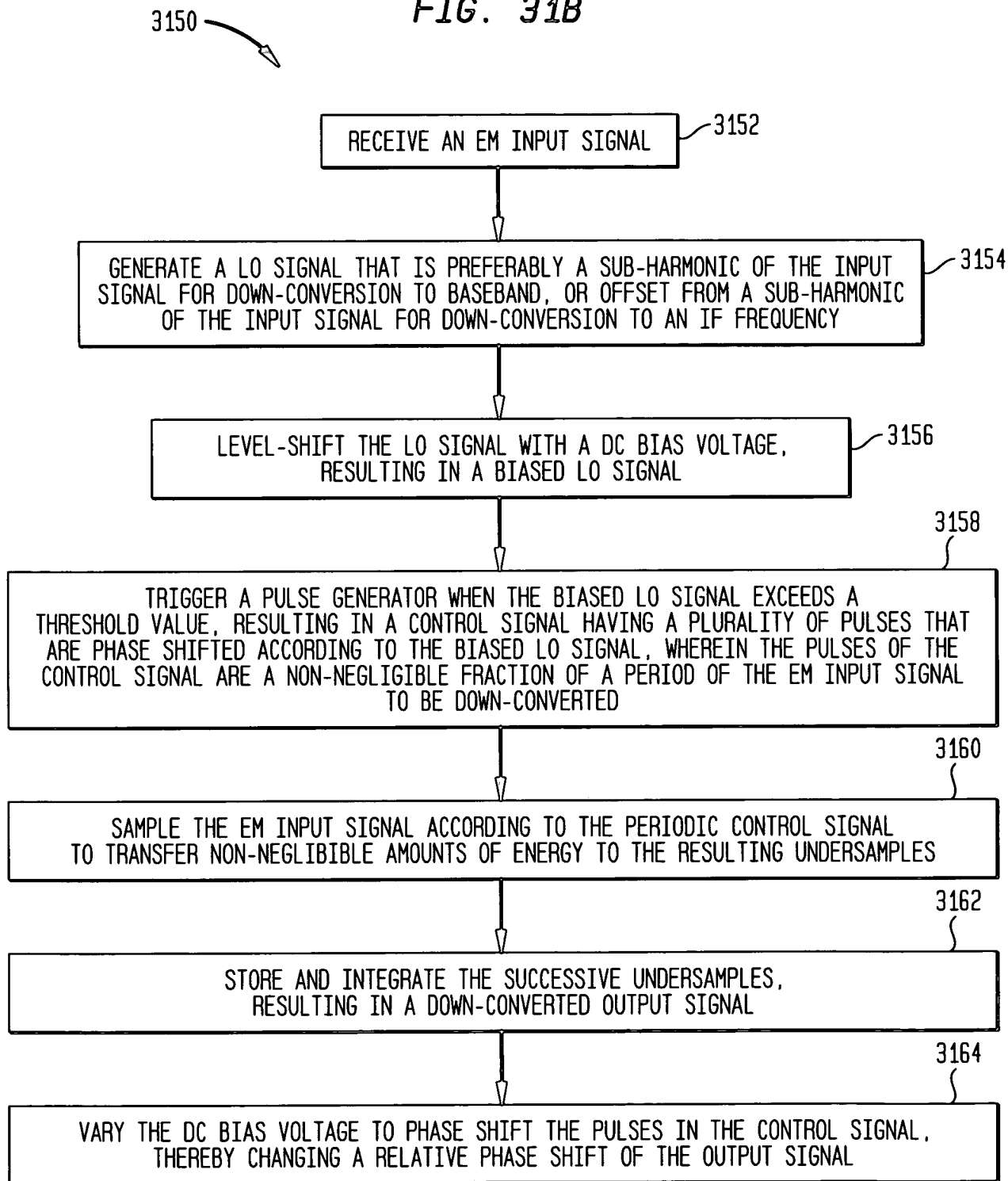


FIG. 310

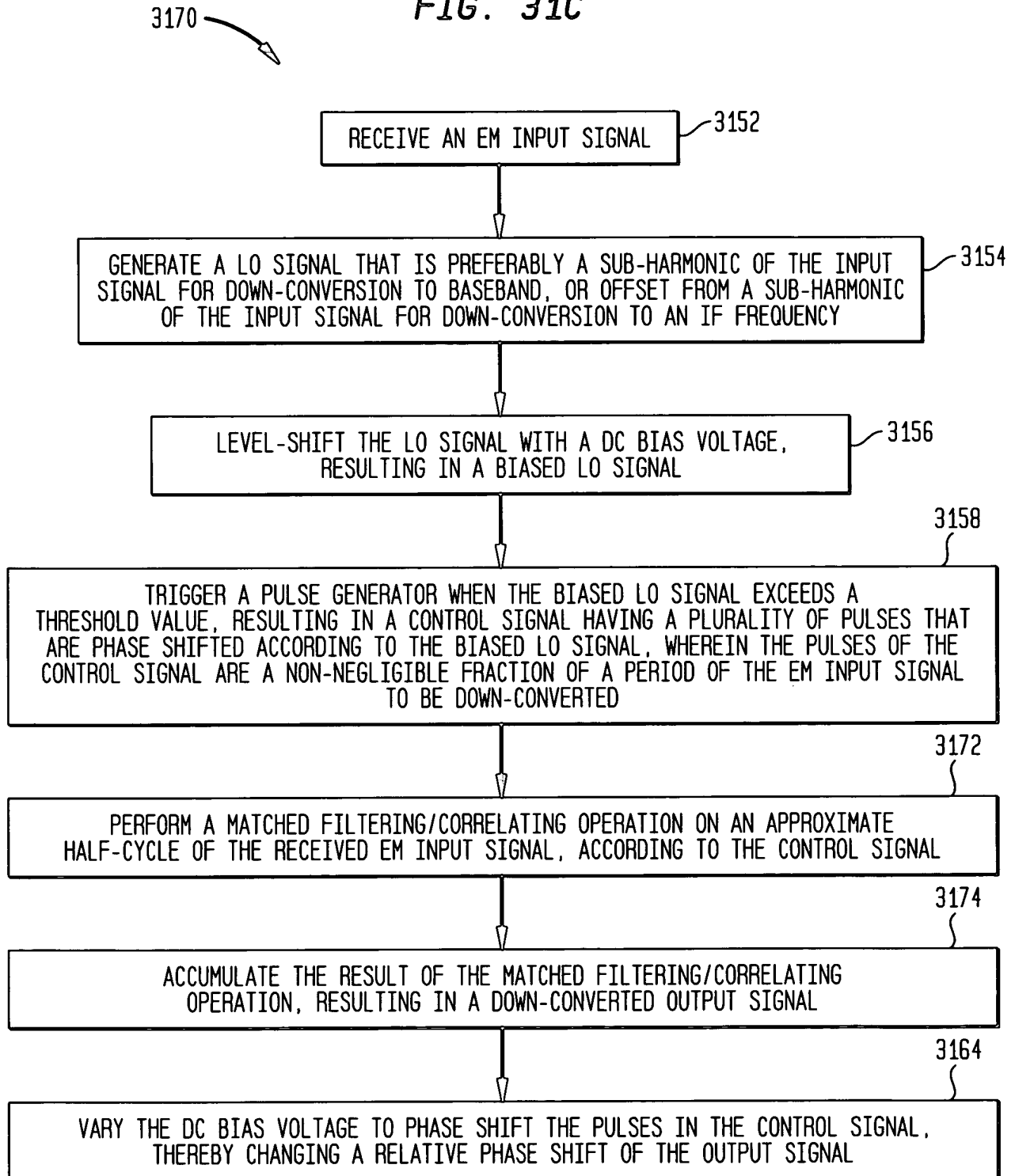


FIG. 32A

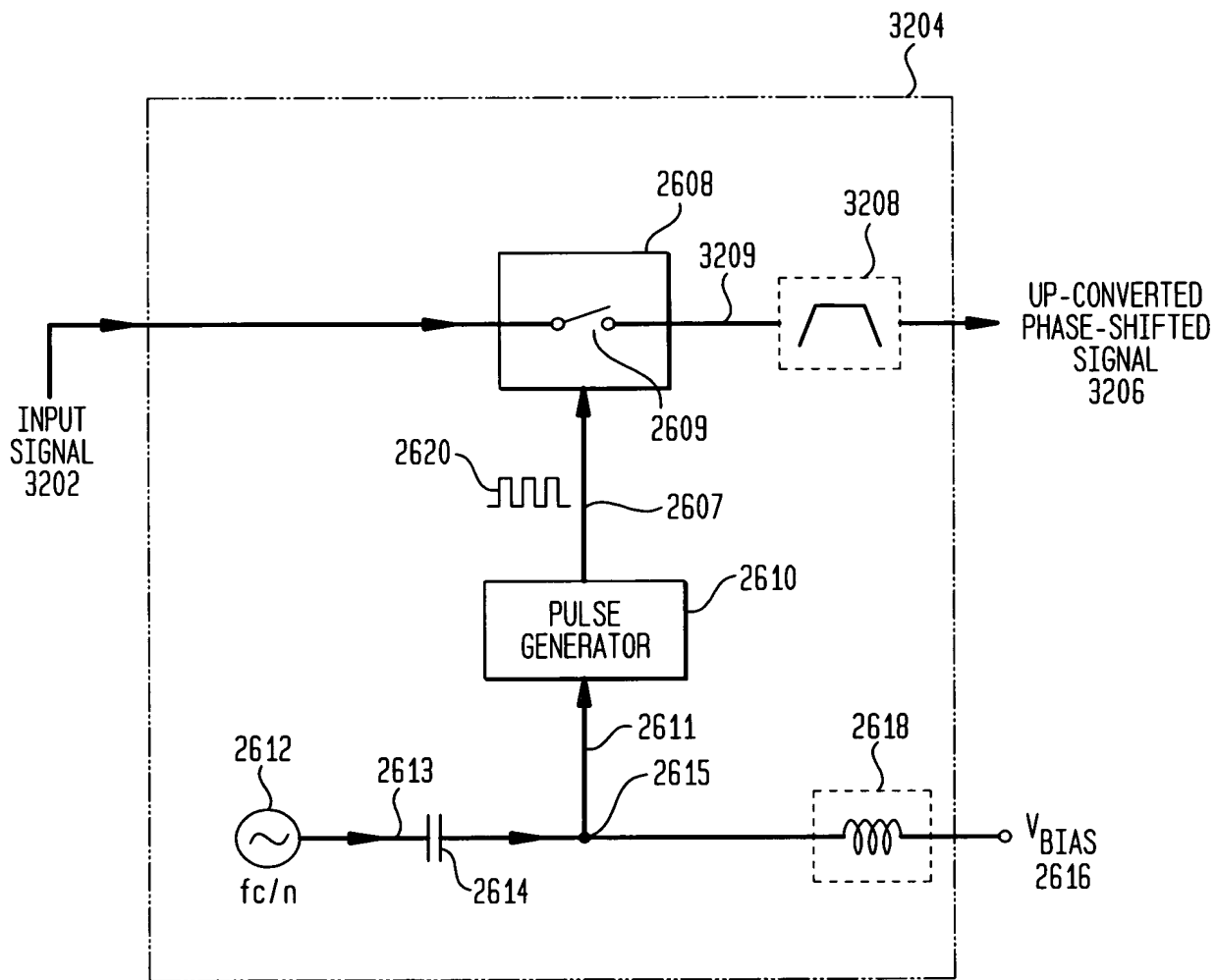


FIG. 32B

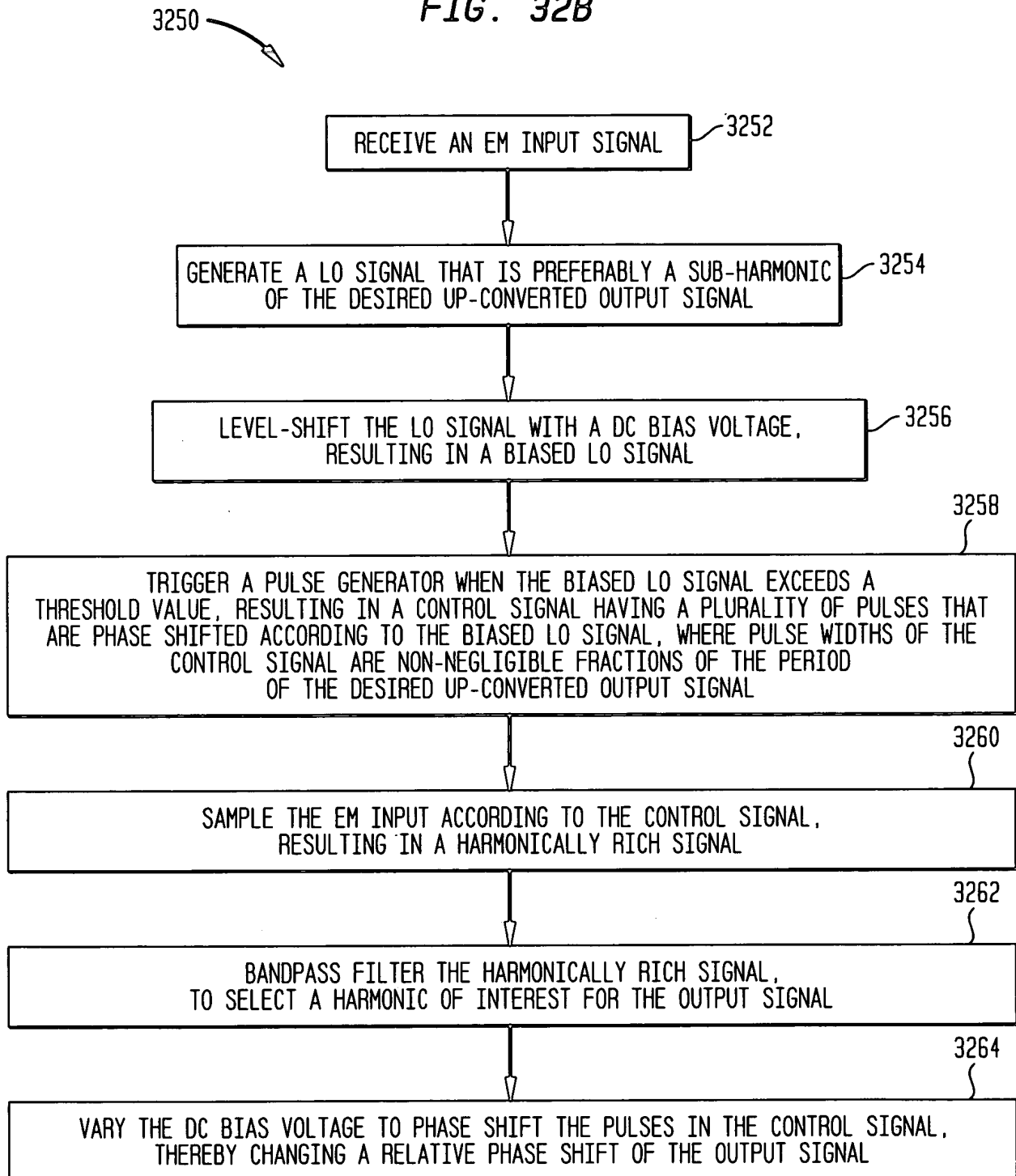


FIG. 32C

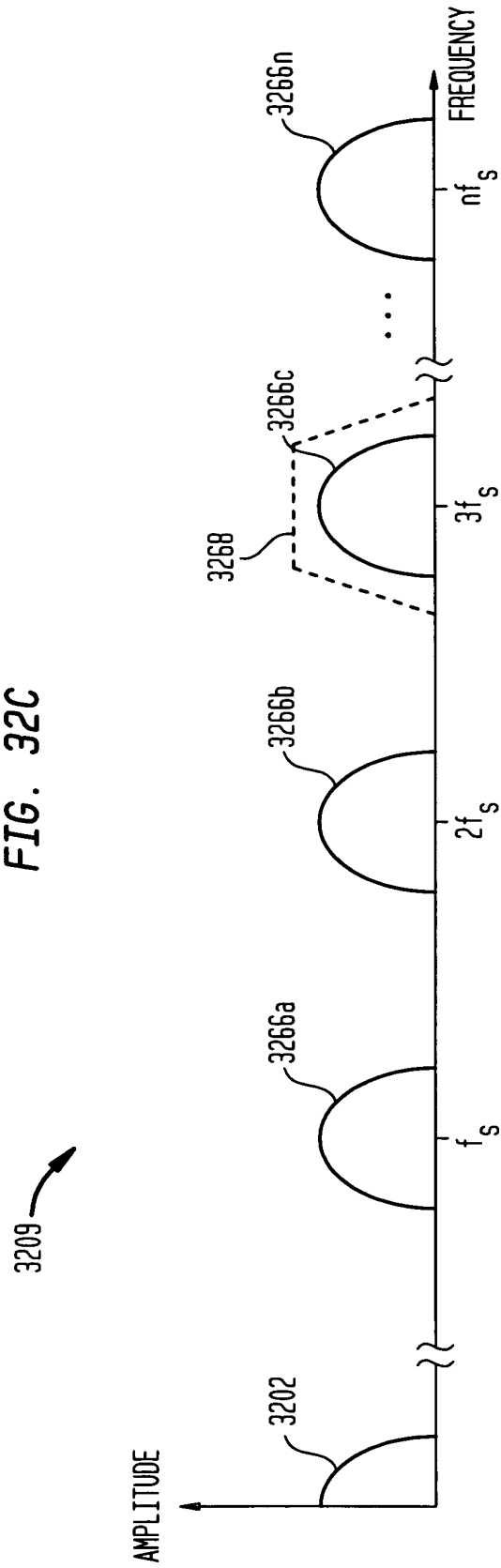


FIG. 33A

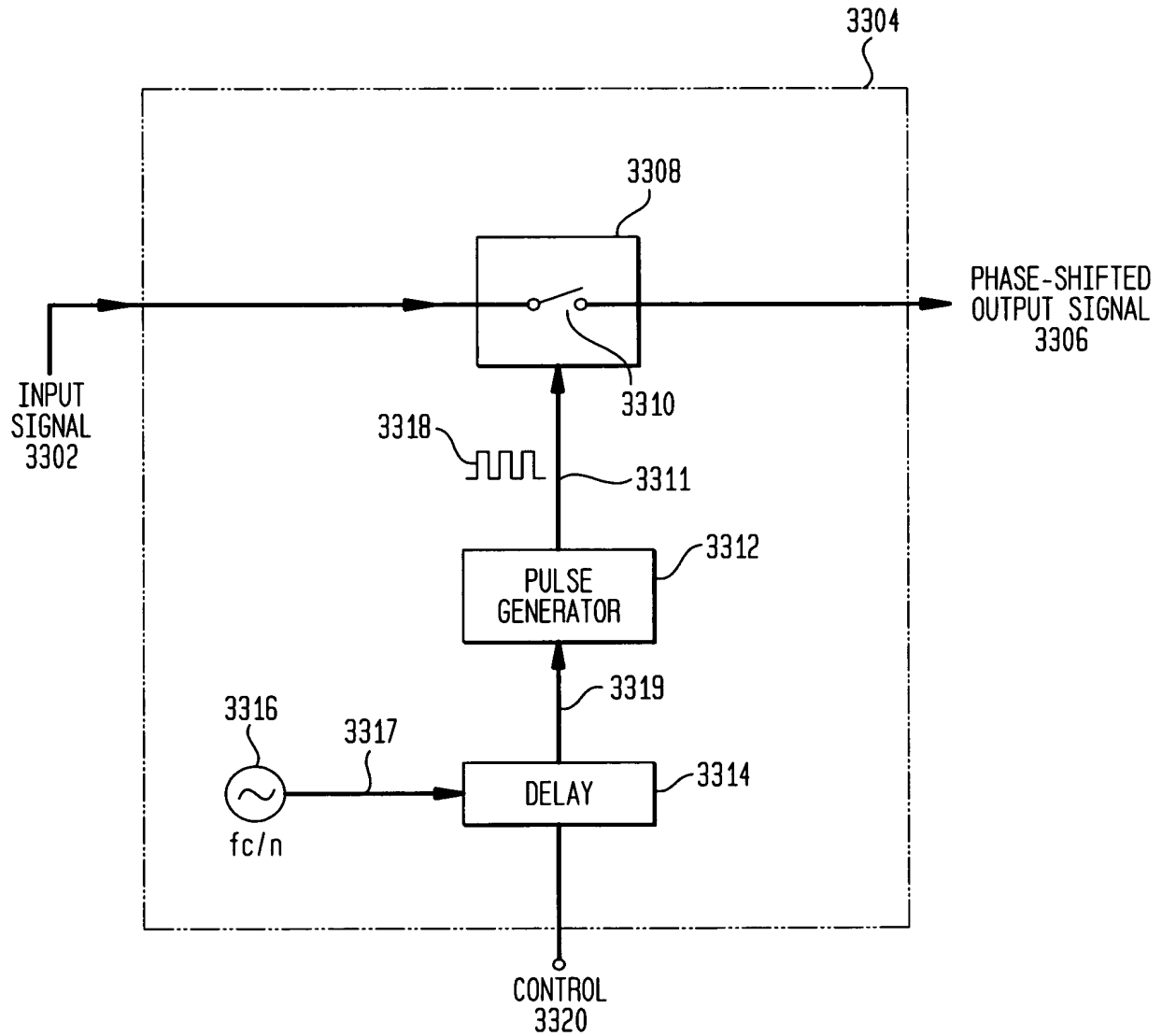
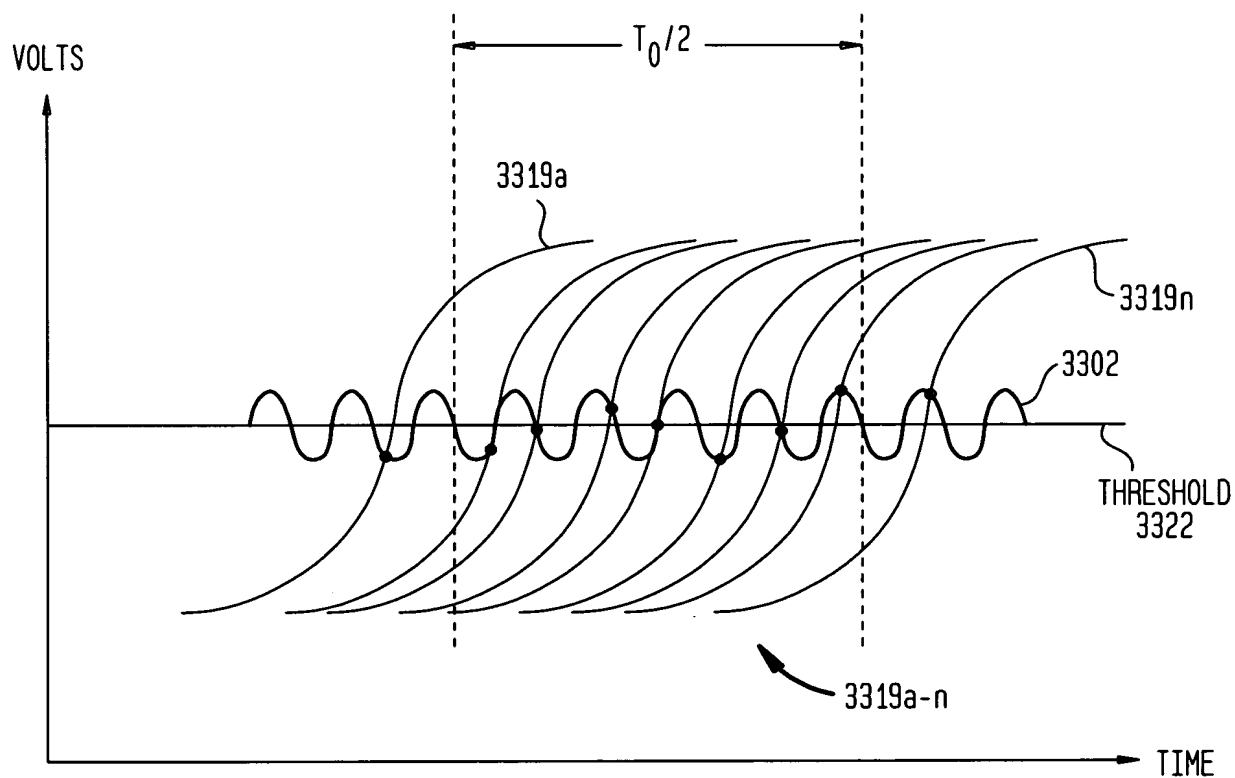


FIG. 33B



3350

FIG. 33C

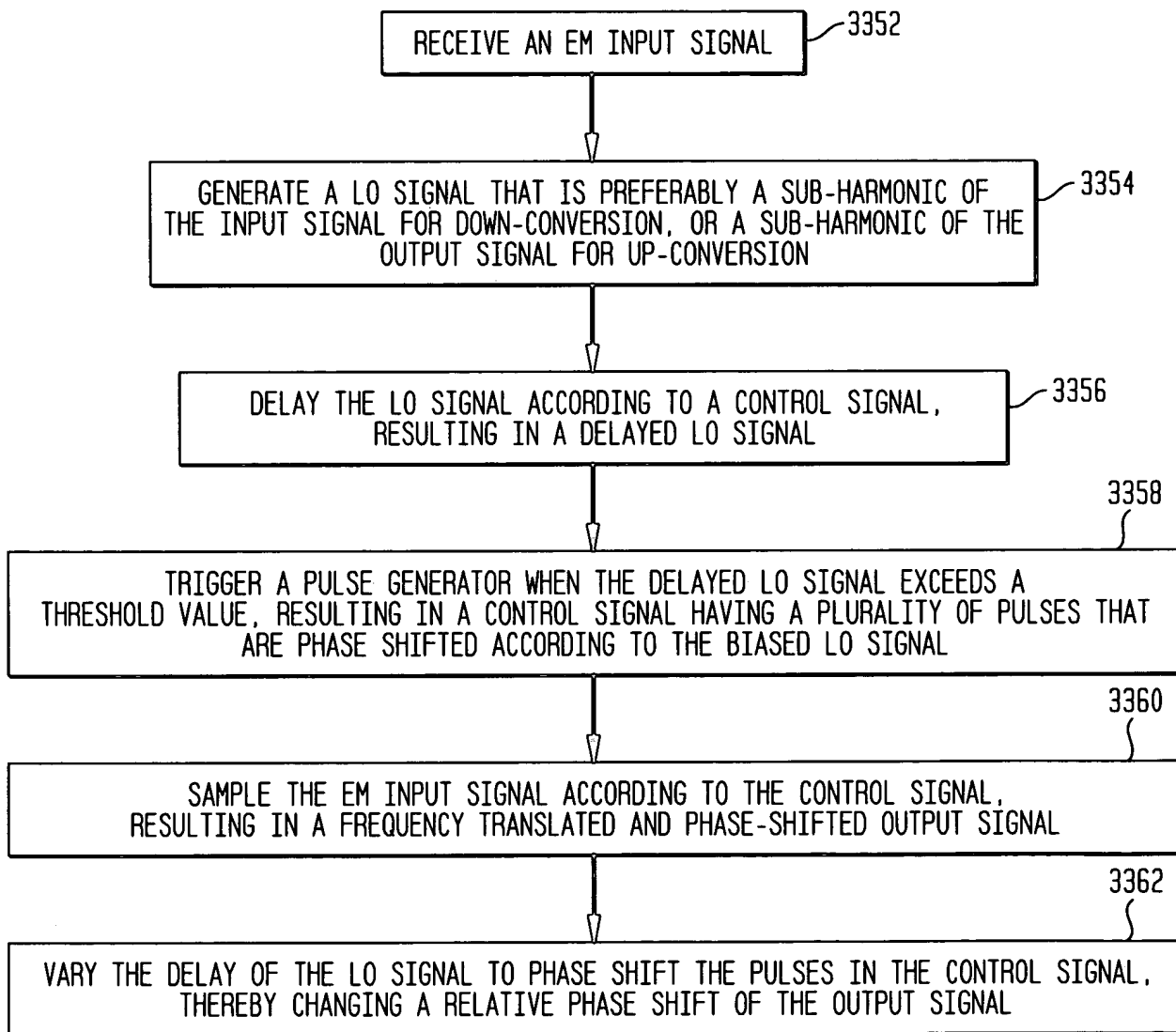


FIG. 33D

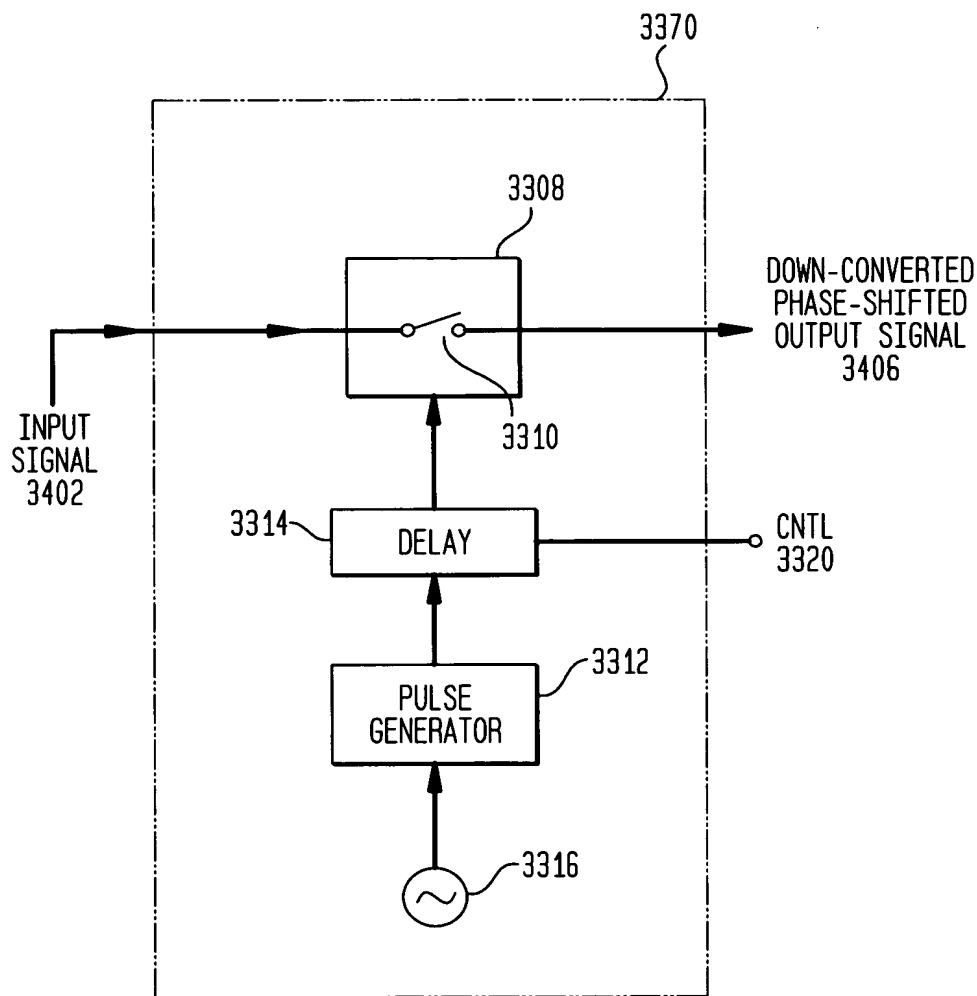


FIG. 34A

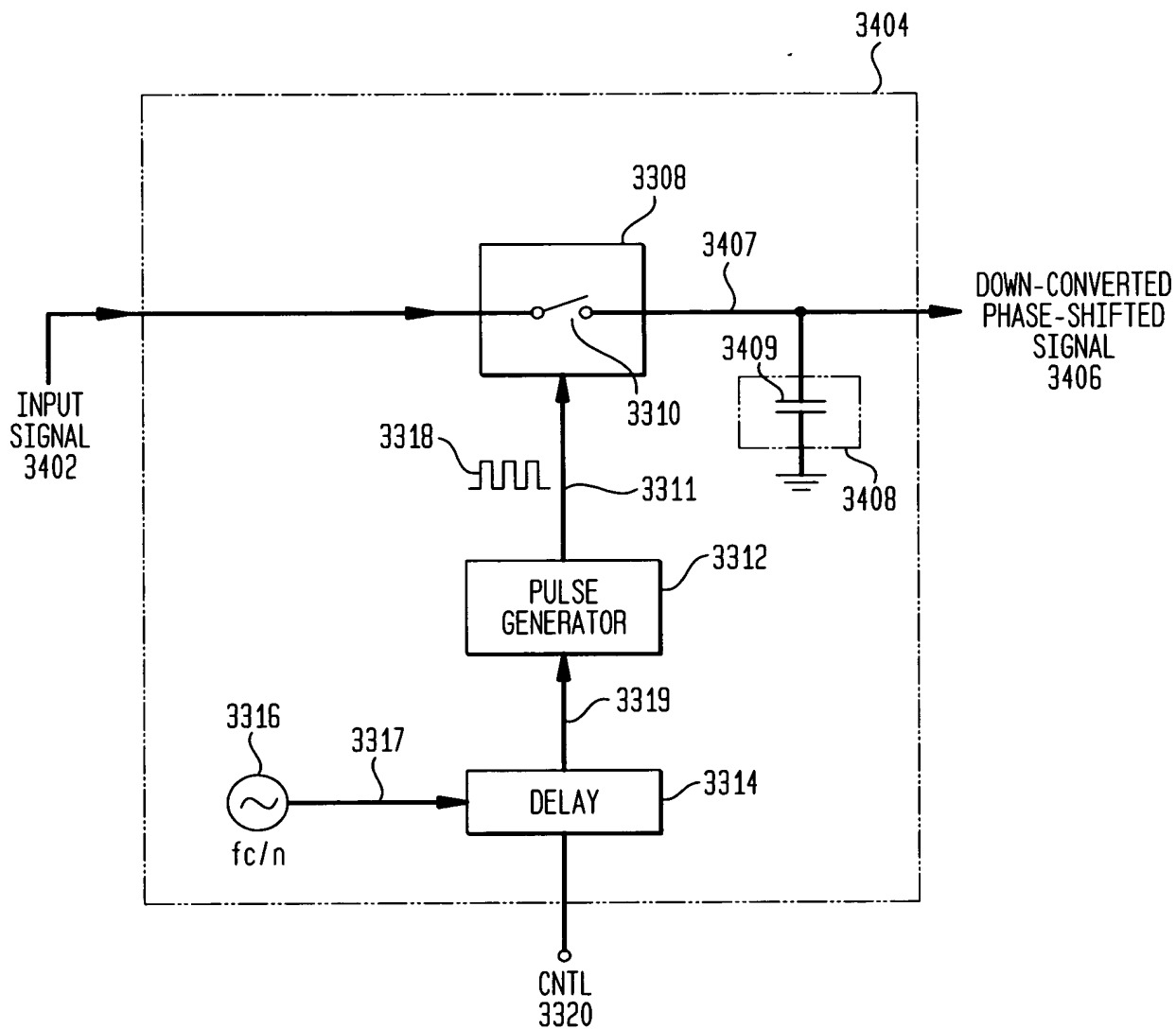


FIG. 34B

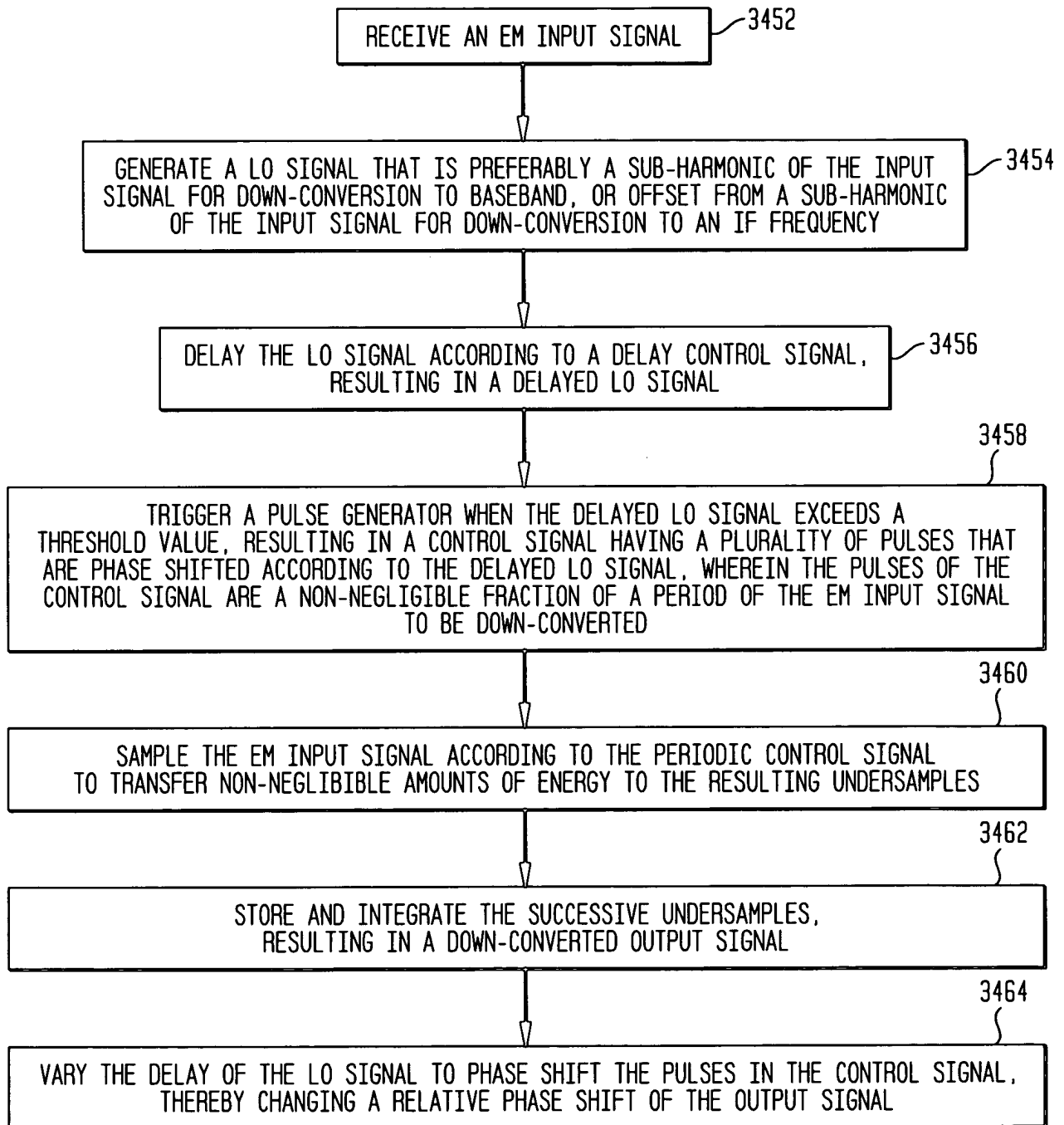


FIG. 35A

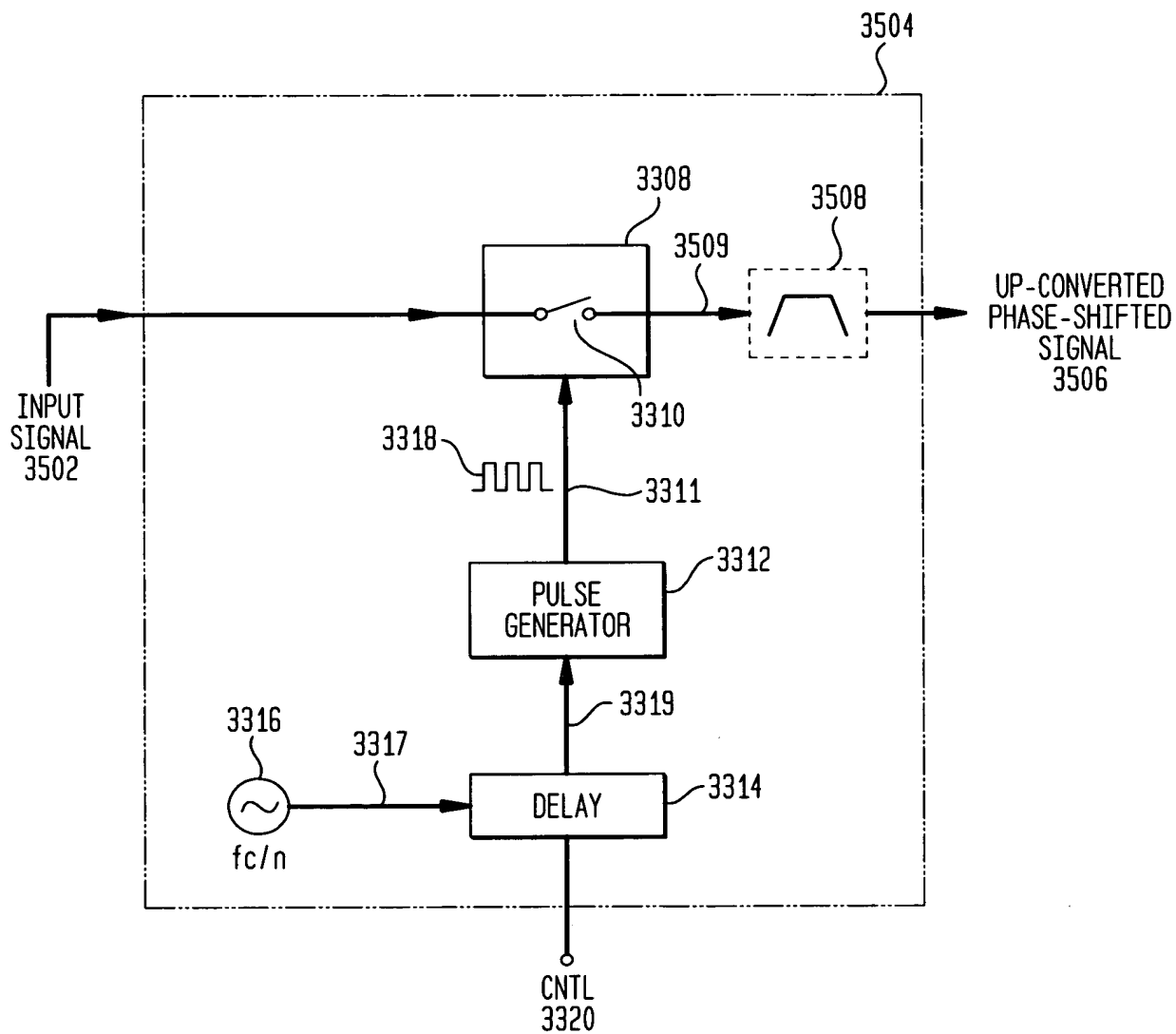


FIG. 35B

3550

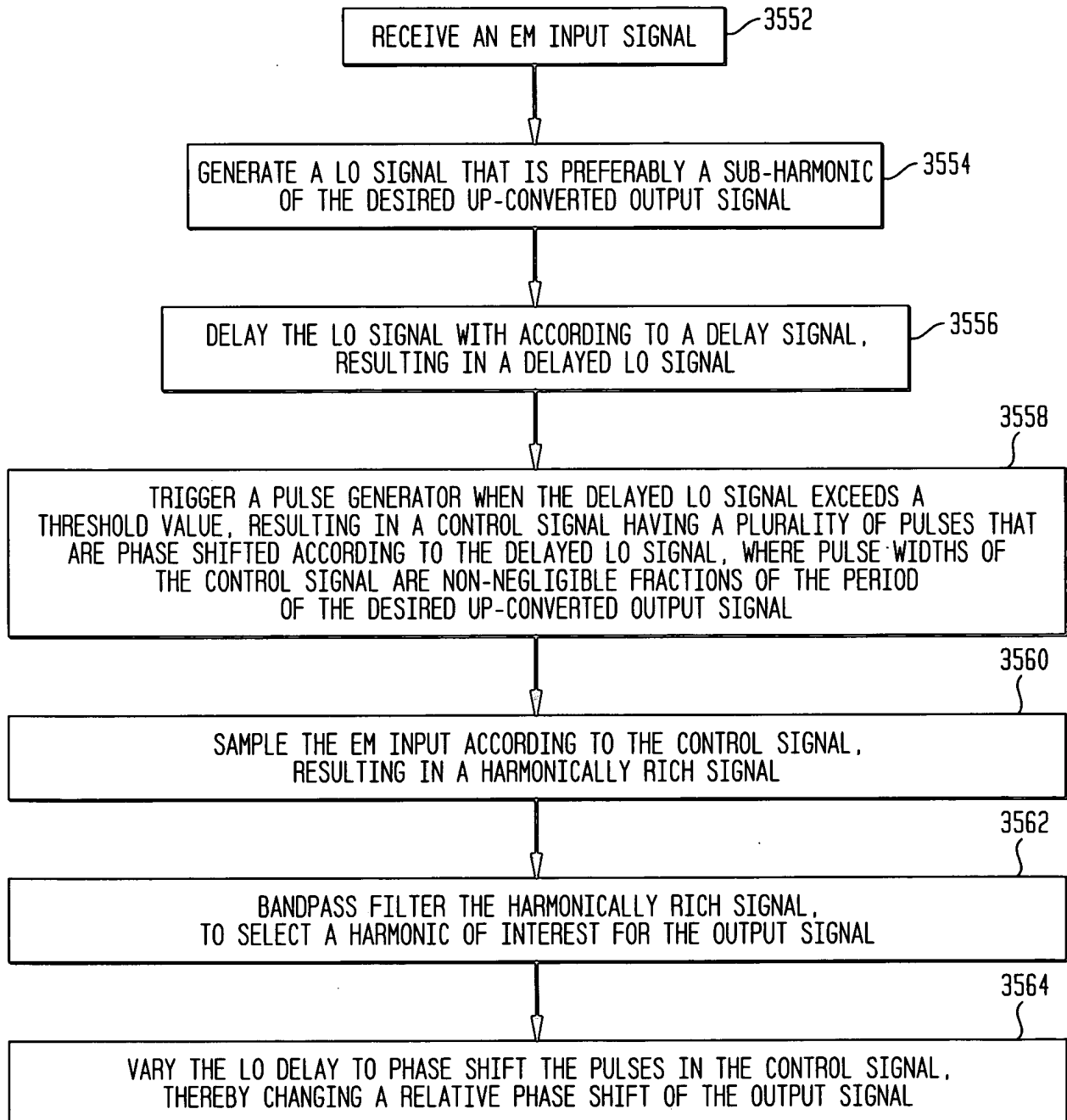


FIG. 35C

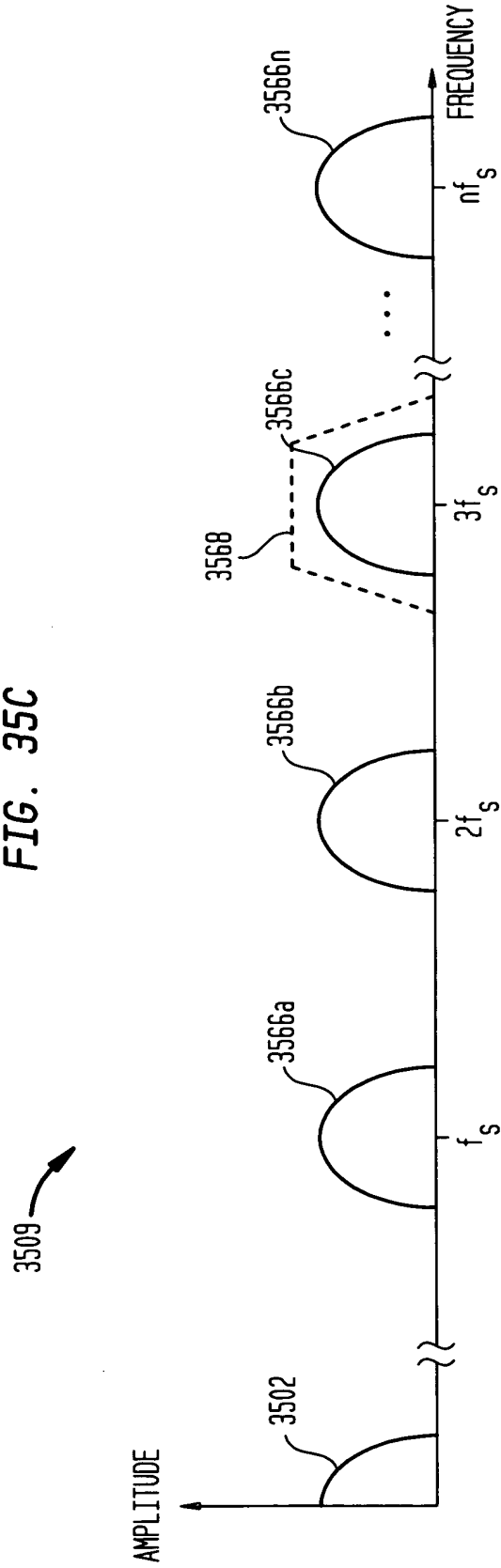


FIG. 36

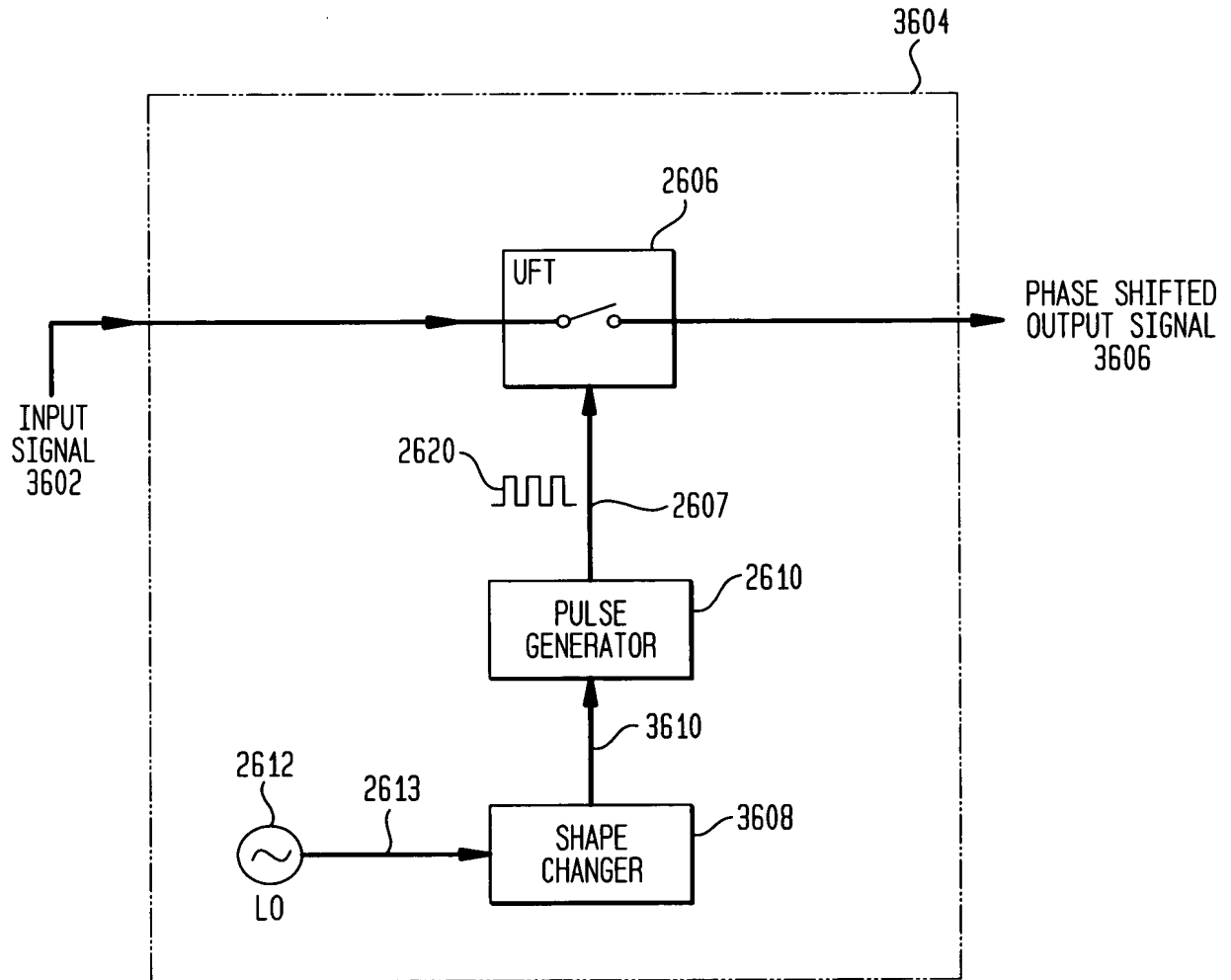


FIG. 37

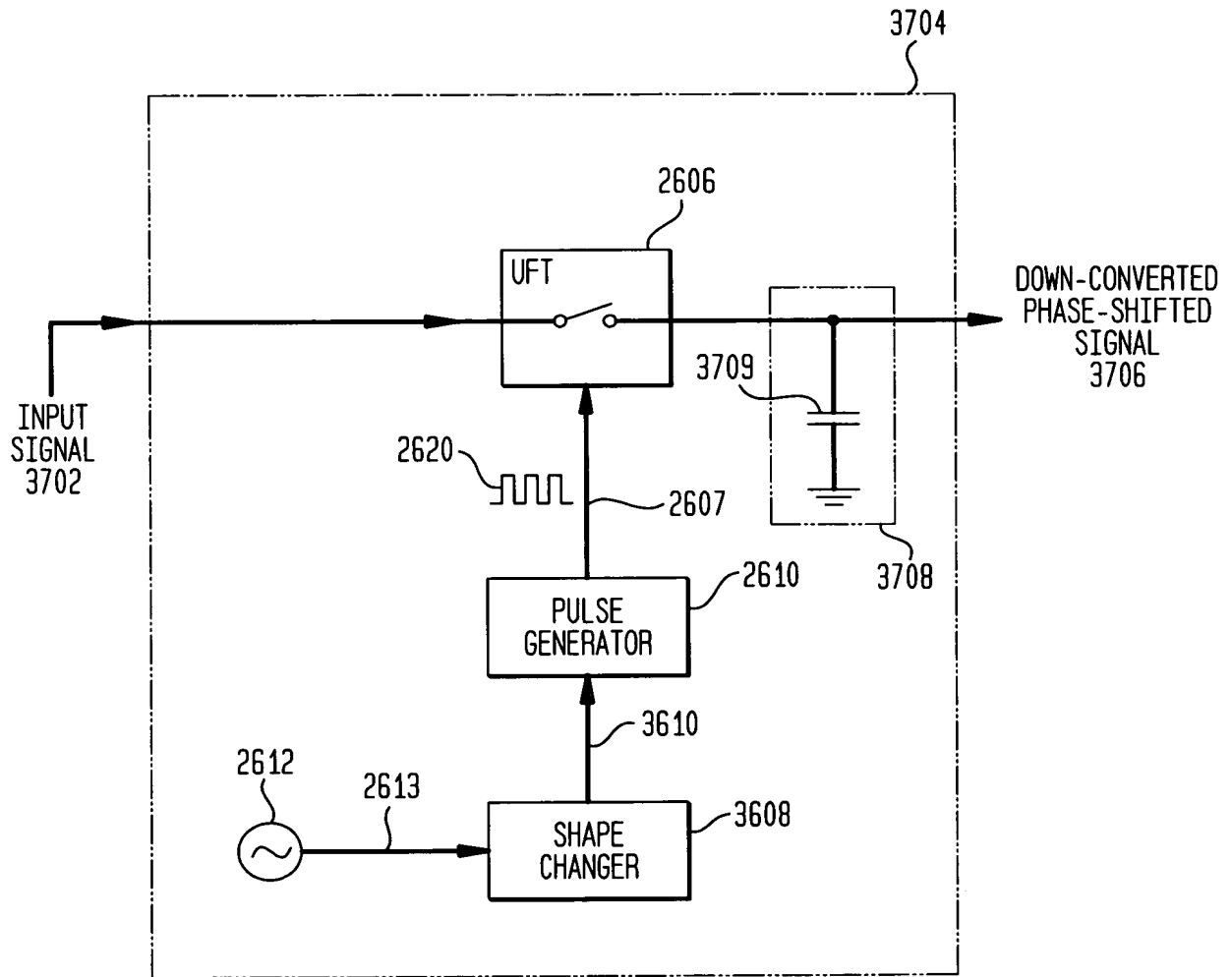


FIG. 38

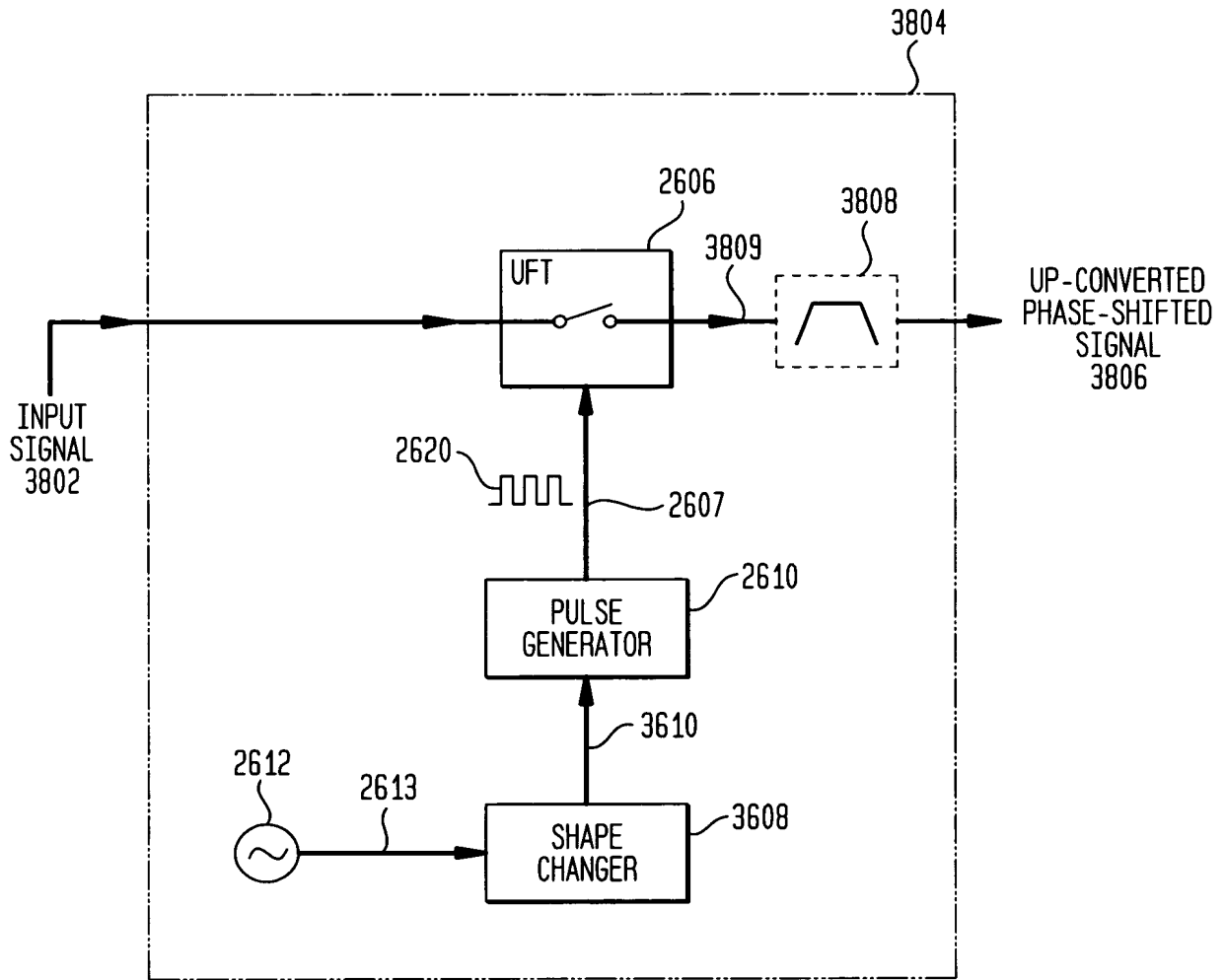


FIG. 39

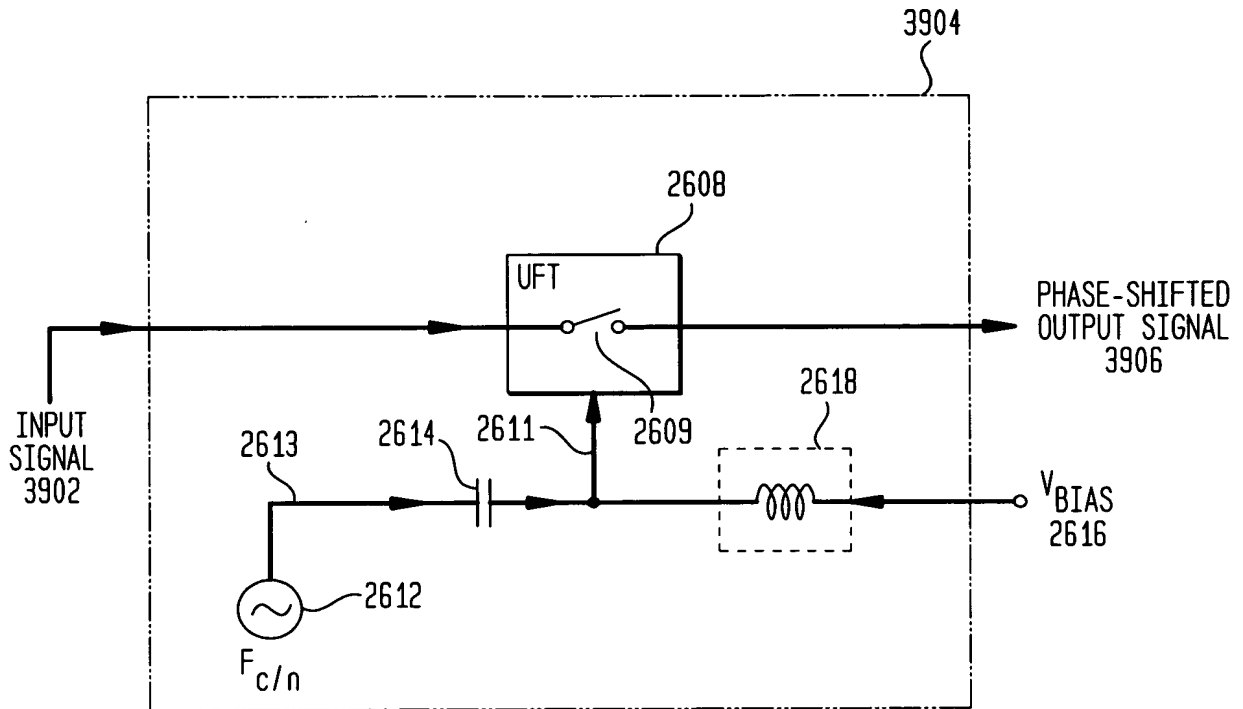


FIG. 40

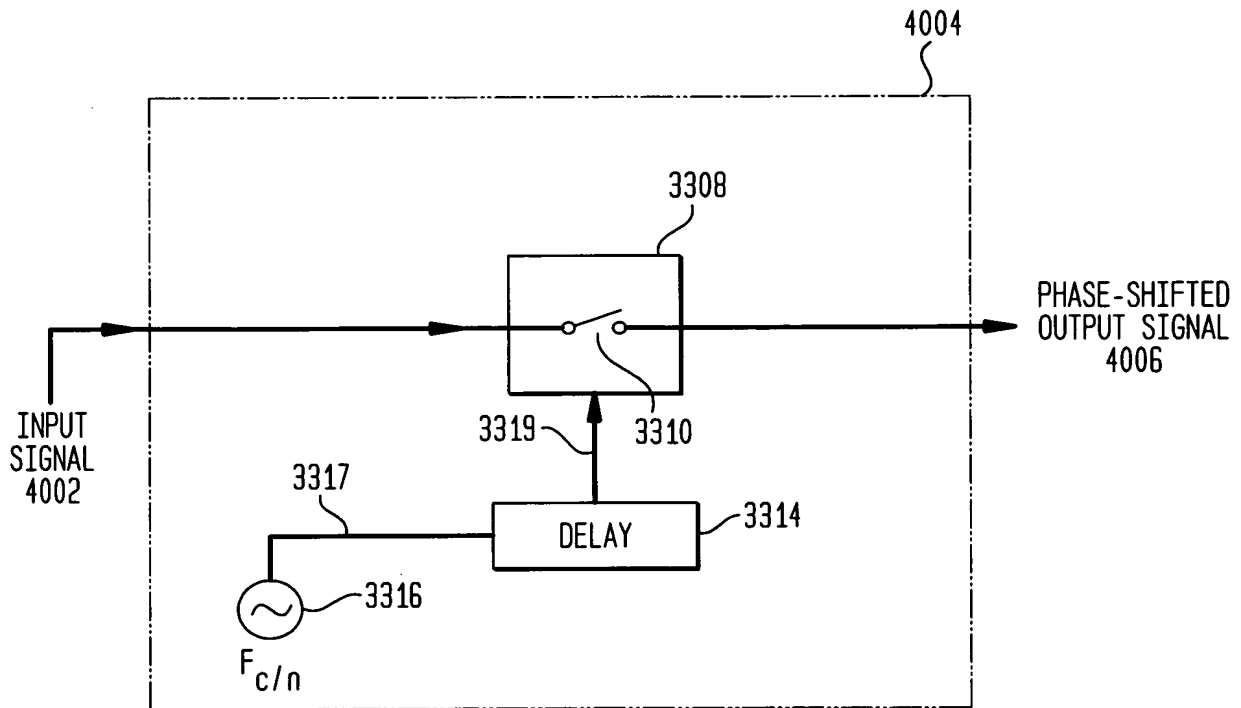


FIG. 41

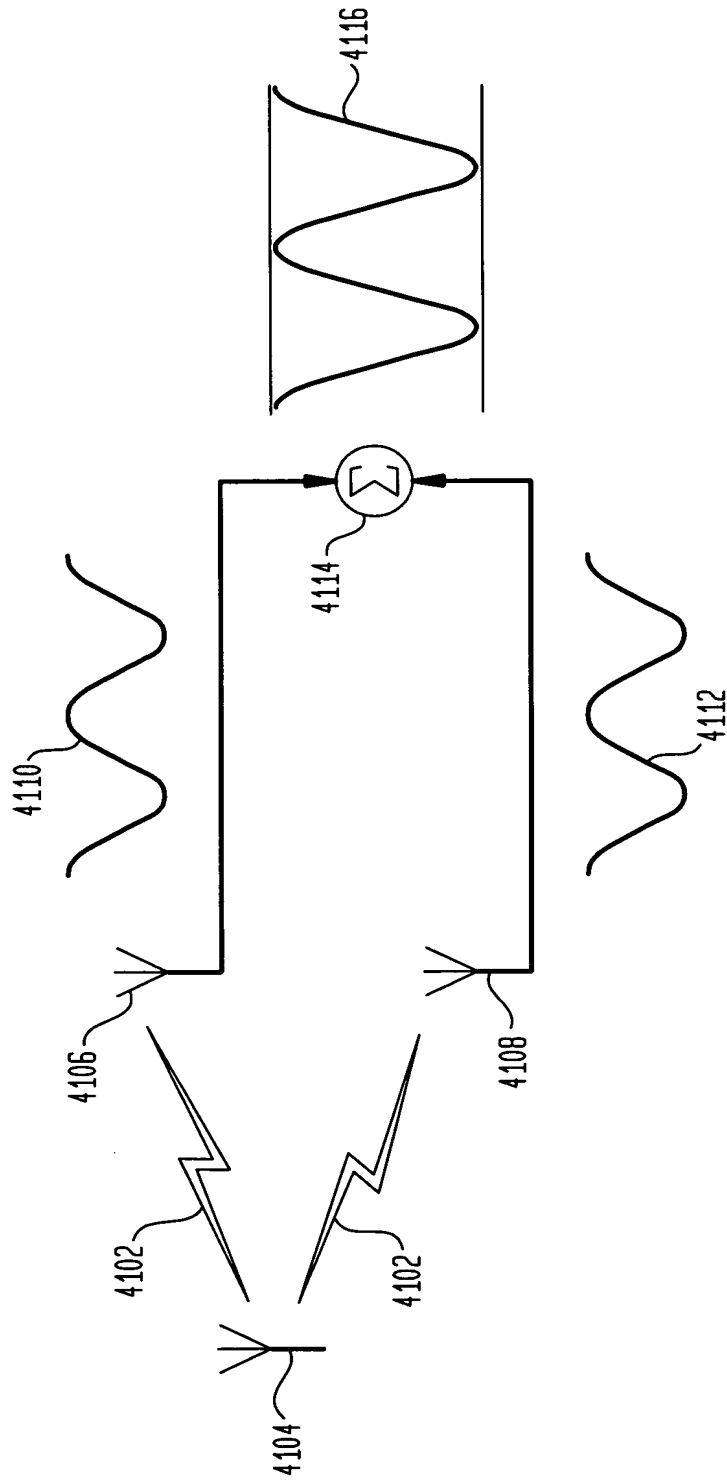


FIG. 42

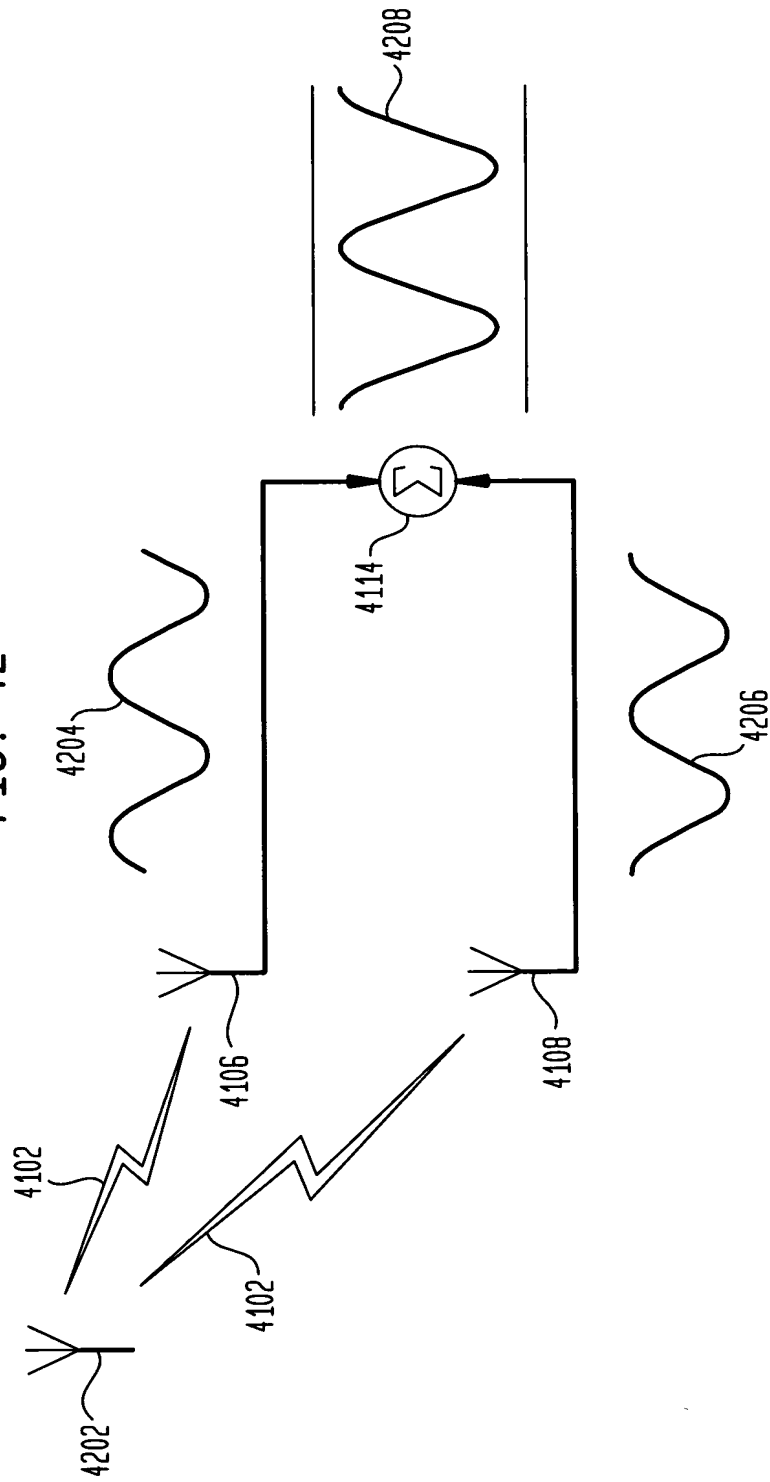


FIG. 43

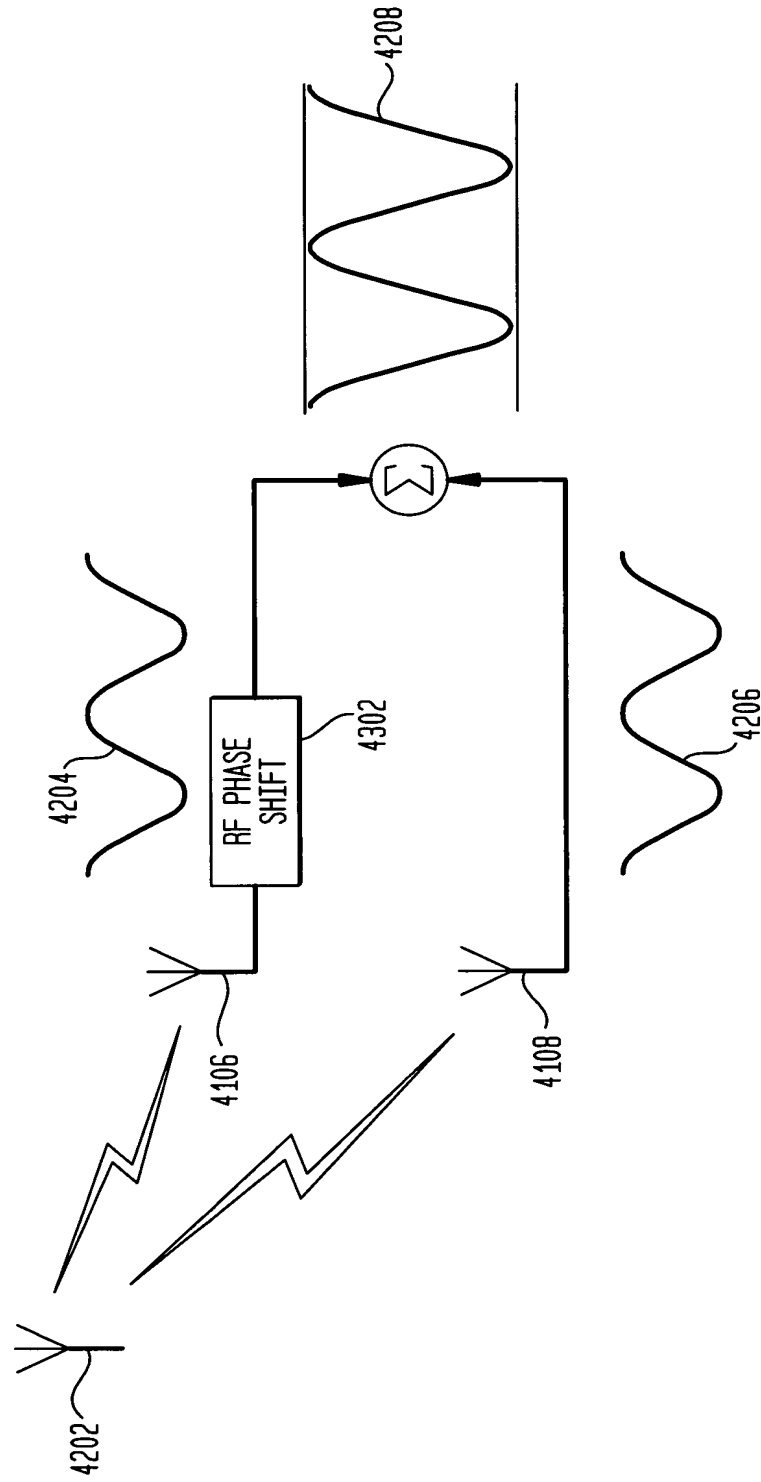


FIG. 44A
NO RF PHASE SHIFT

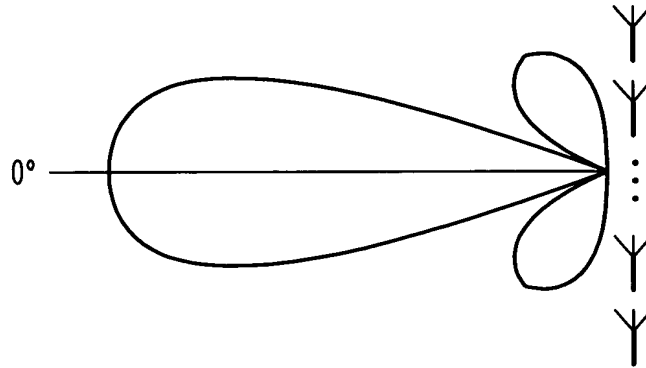


FIG. 44B
RF PHASE SHIFT

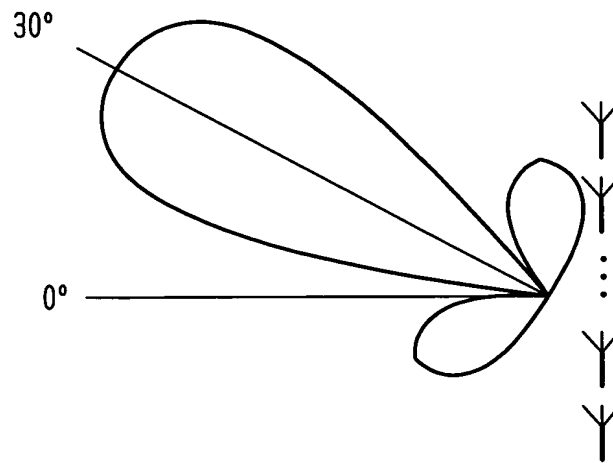


FIG. 45A
HALF-WAVE DIPOLE

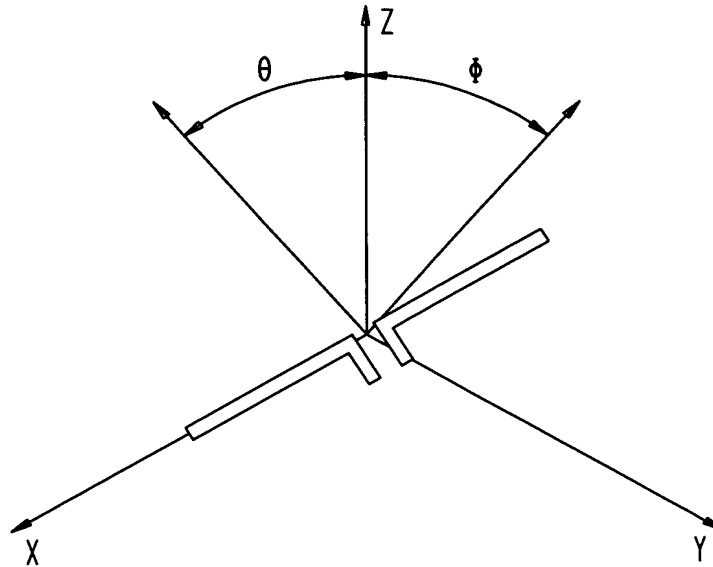


FIG. 45B
E-PLANE ELEMENT FACTOR FOR A
HALF-WAVE DIPOLE

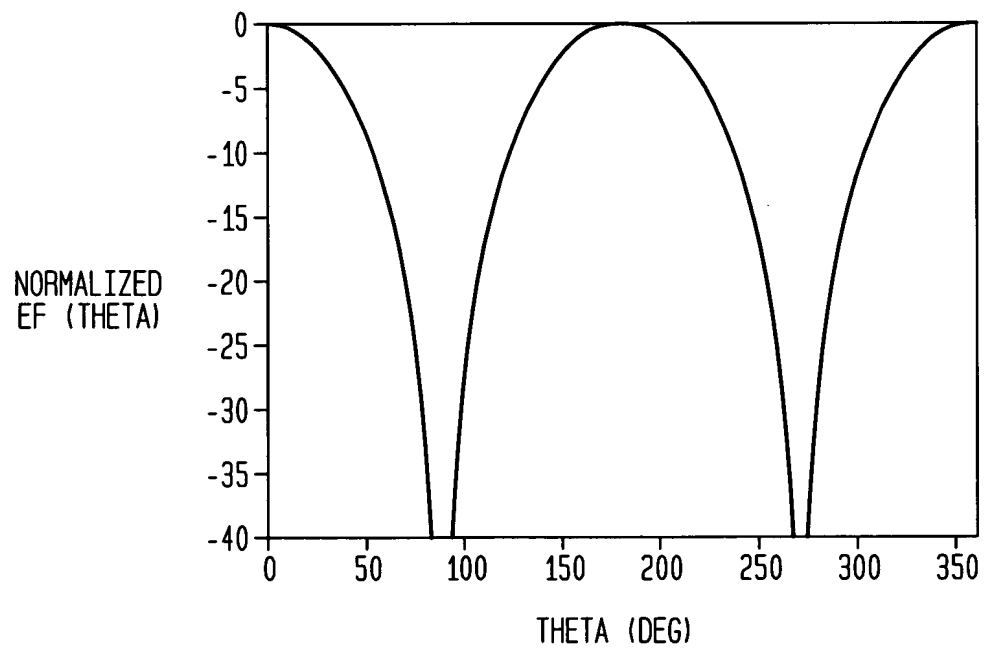


FIG. 46
 AN N-ELEMENT LINEAR ANTENNA ARRAY

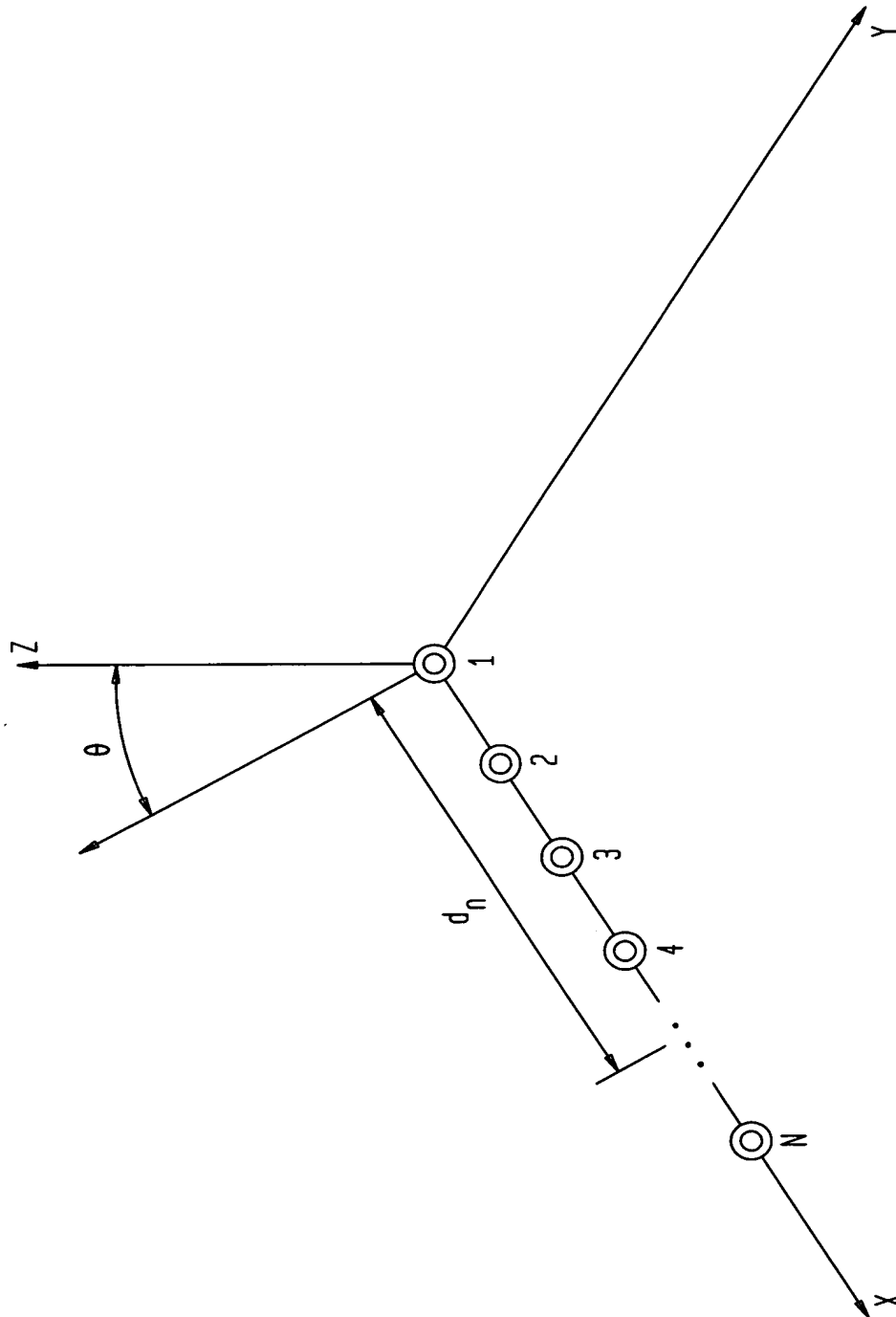


FIG. 47

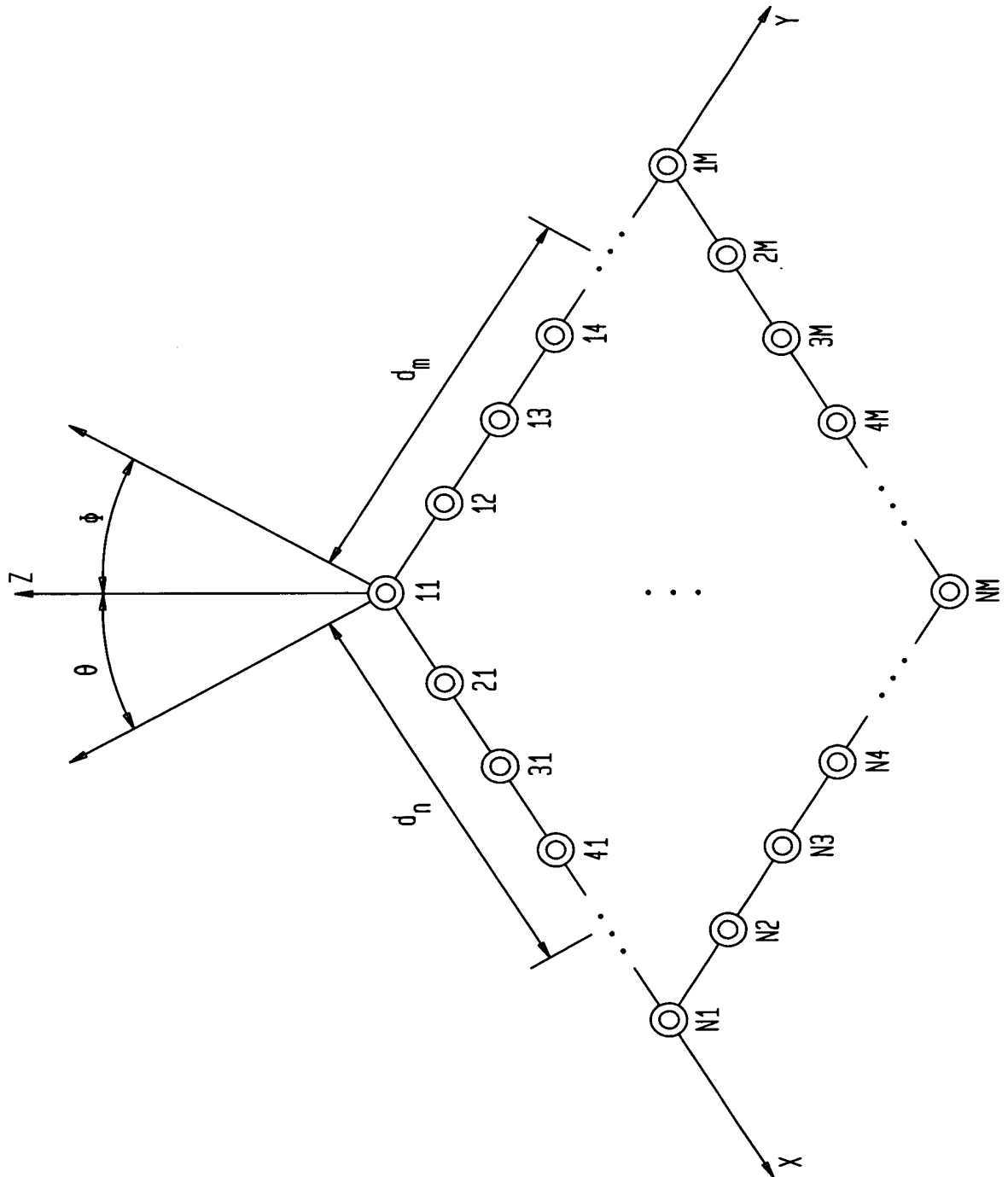


FIG. 48

A LINEAR ARRAY OF FIVE
HALF WAVE DIPOLES

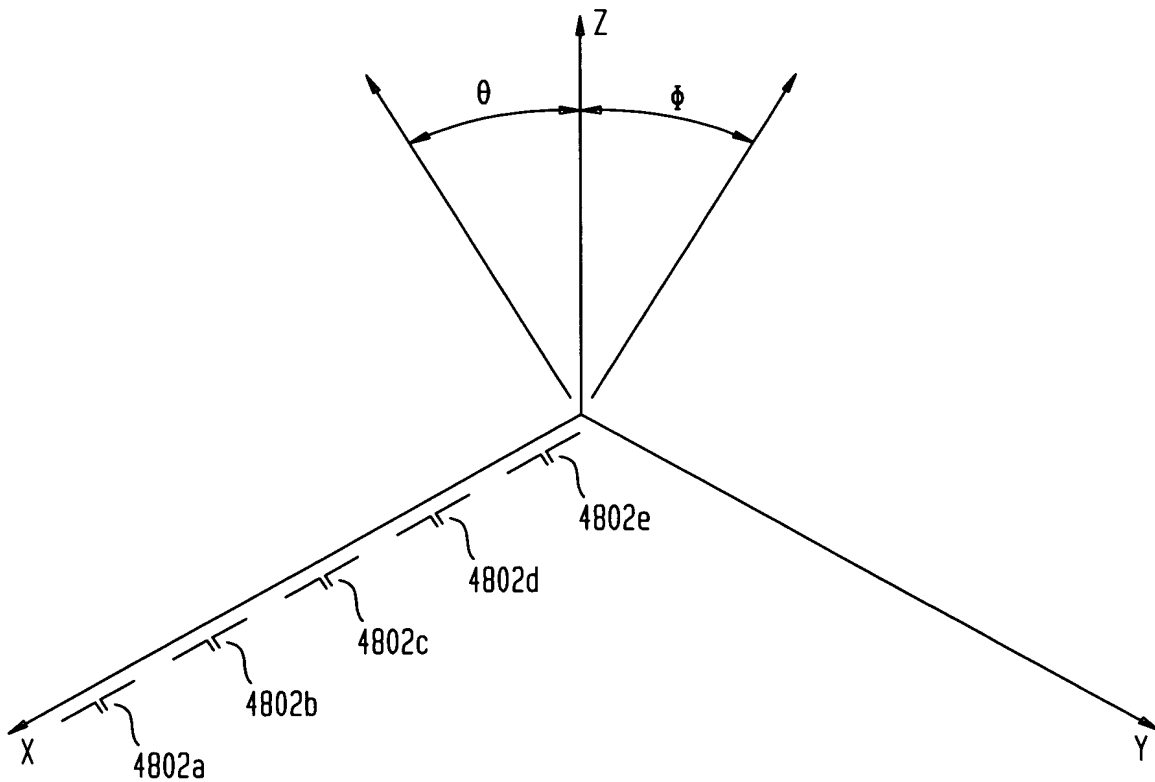


FIG. 49A

ARRAY FACTOR FOR A LINEAR ARRAY
OF 5 HALF WAVE DIPOLES

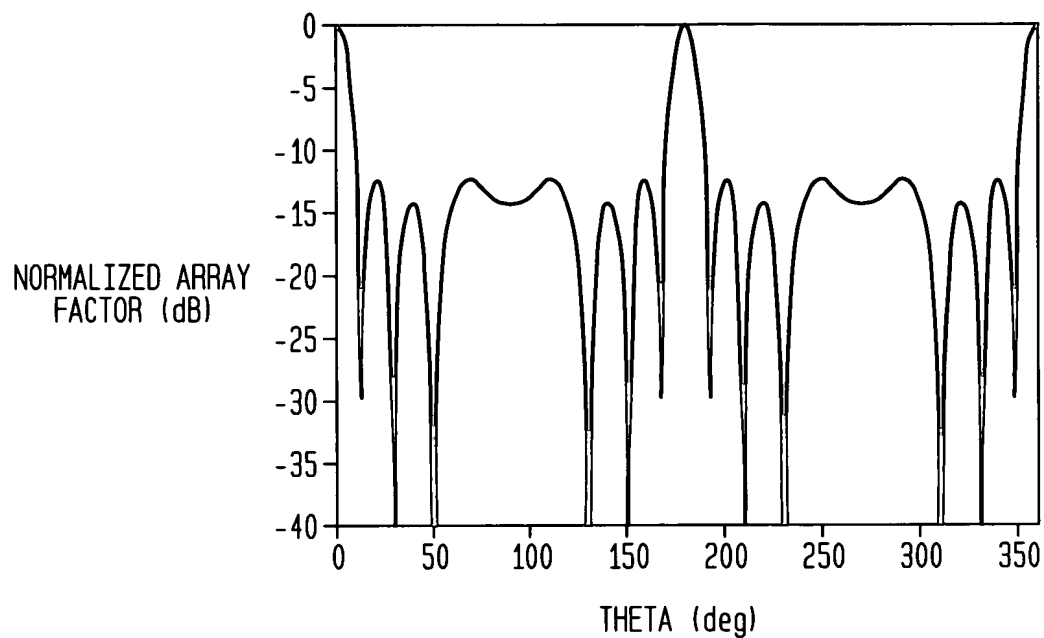


FIG. 49B

RADIATION PATTERN FOR A LINEAR ARRAY
OF 5 HALF WAVE DIPOLES

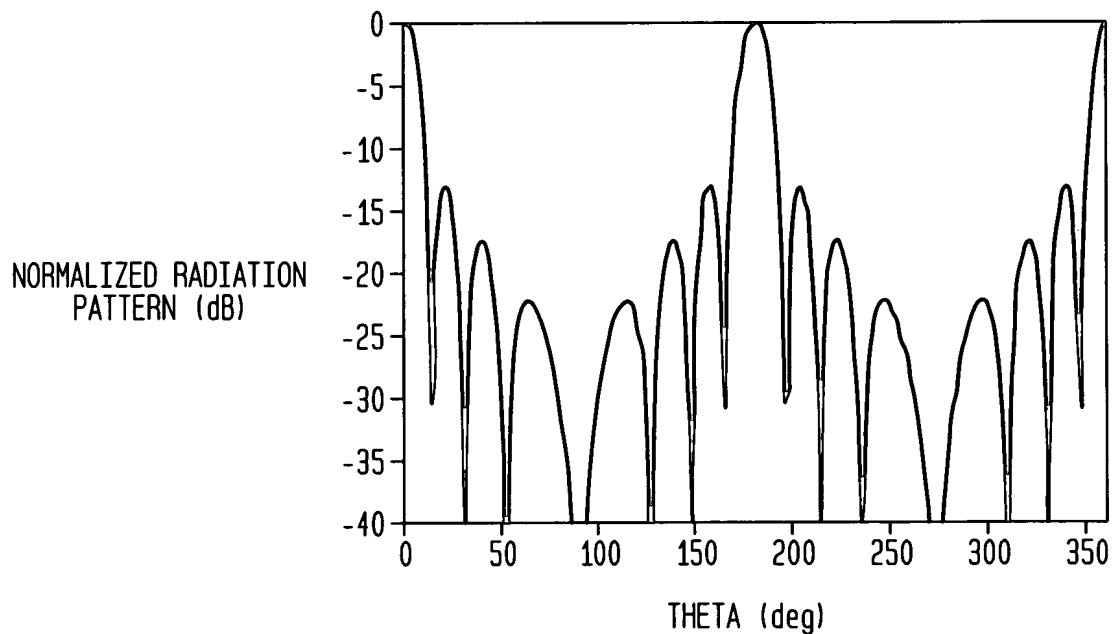


FIG. 50A

ARRAY FACTOR, UNIFORM AMPLITUDE DISTRIBUITION

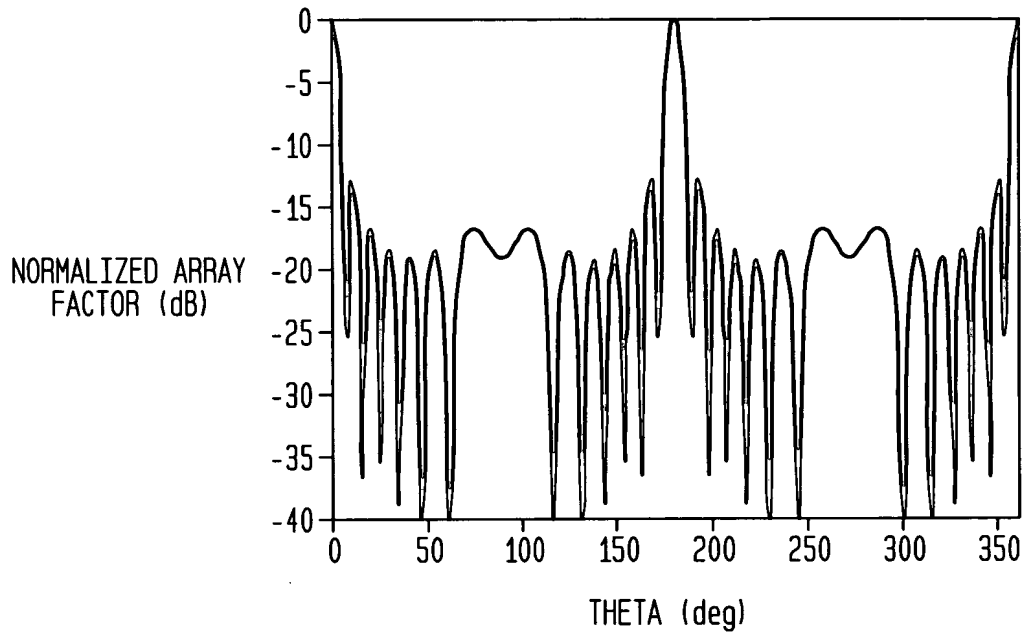


FIG. 50B

ARRAY FACTOR, RAISED COSINE AMPLITUDE DISTRIBUITION

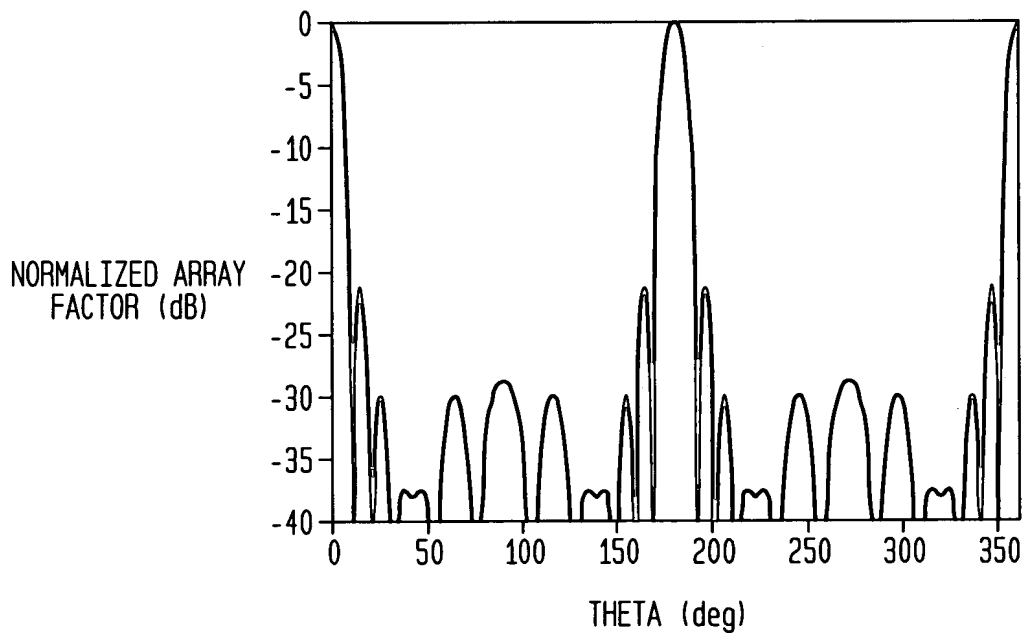


FIG. 51A

ARRAY FACTOR, UNIFORM PHASE DISTRIBUTION
BETA=0 DEGREES

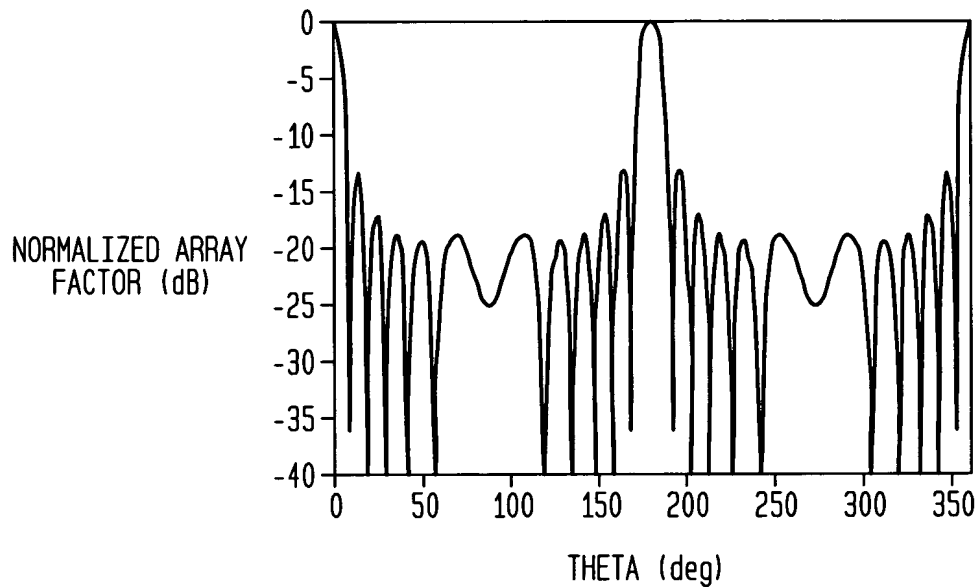
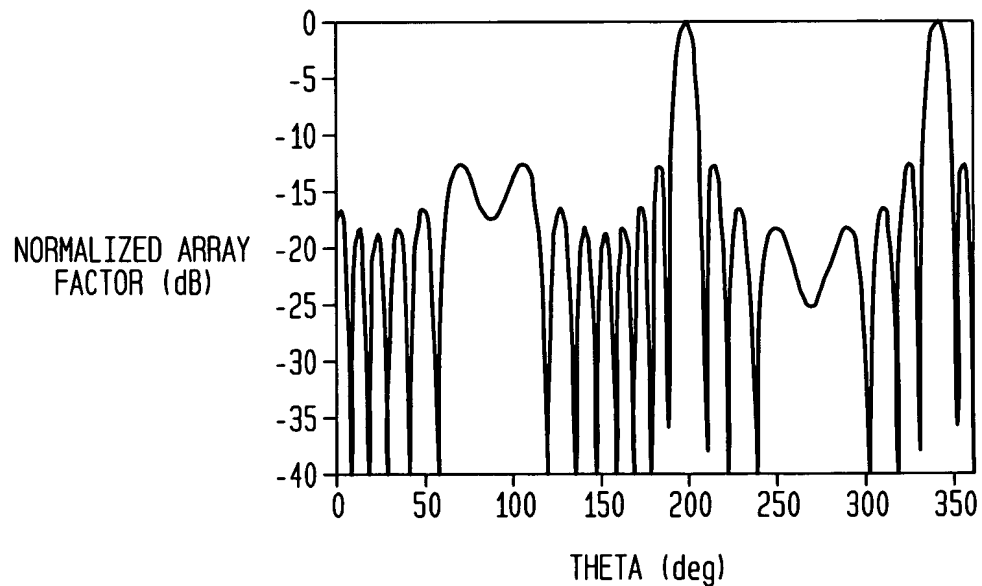


FIG. 51B

ARRAY FACTOR, PROGRESSIVE PHASE DISTRIBUTION
BETA=80 DEGREES



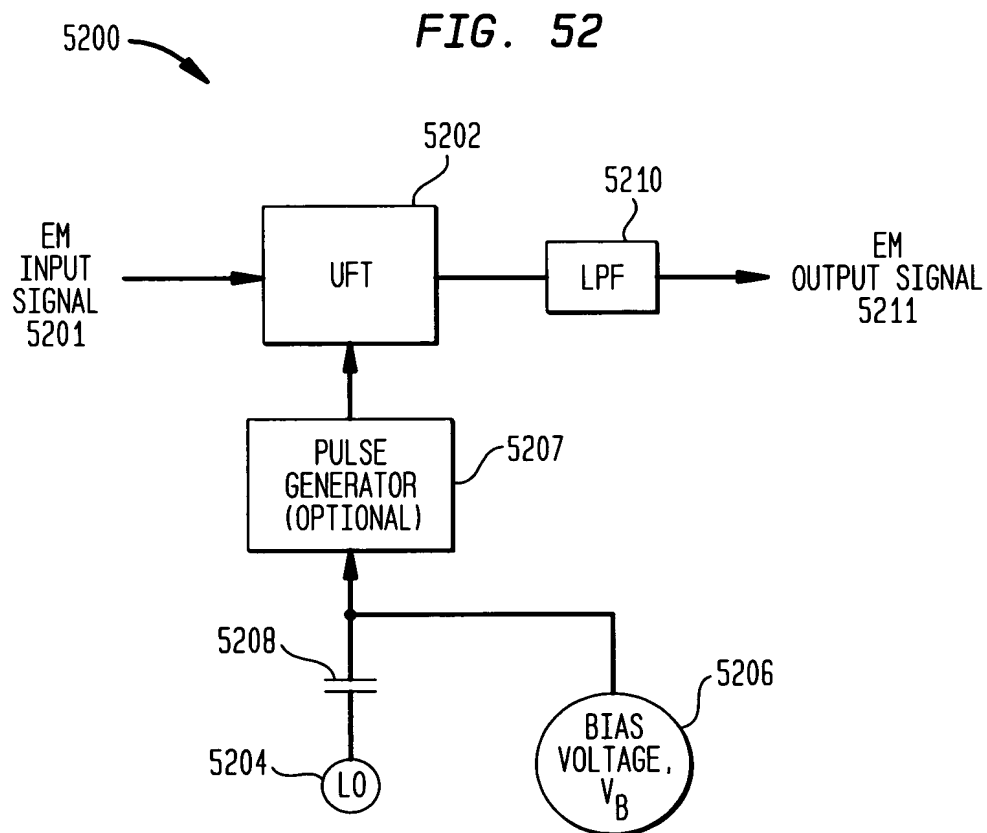


FIG. 53

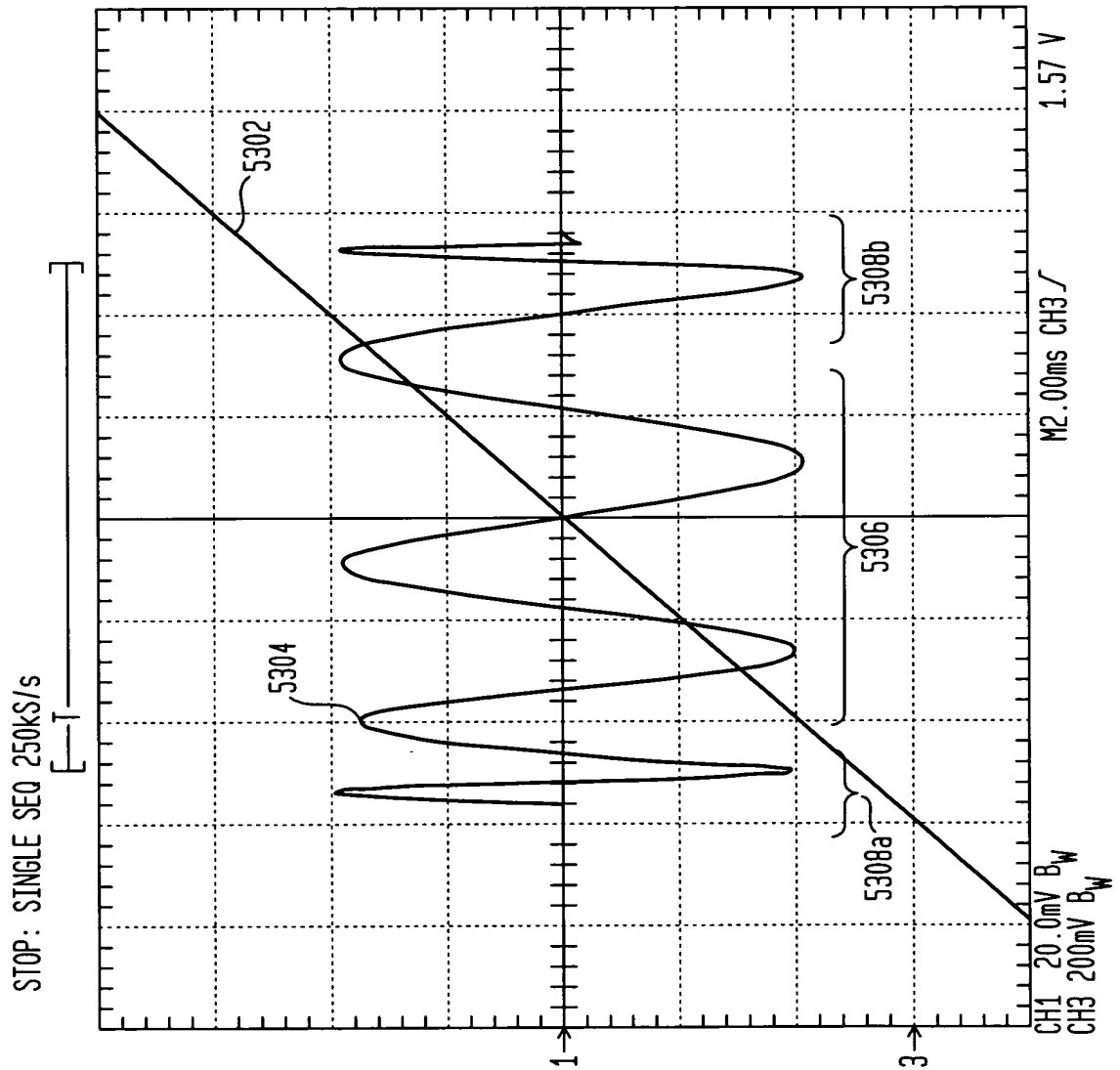


FIG. 54

RANGE OF VALID BIAS VOLTAGES VS. LO AMPLITUDE
 FOR $V_{CC} = 5 \text{ VDC}$

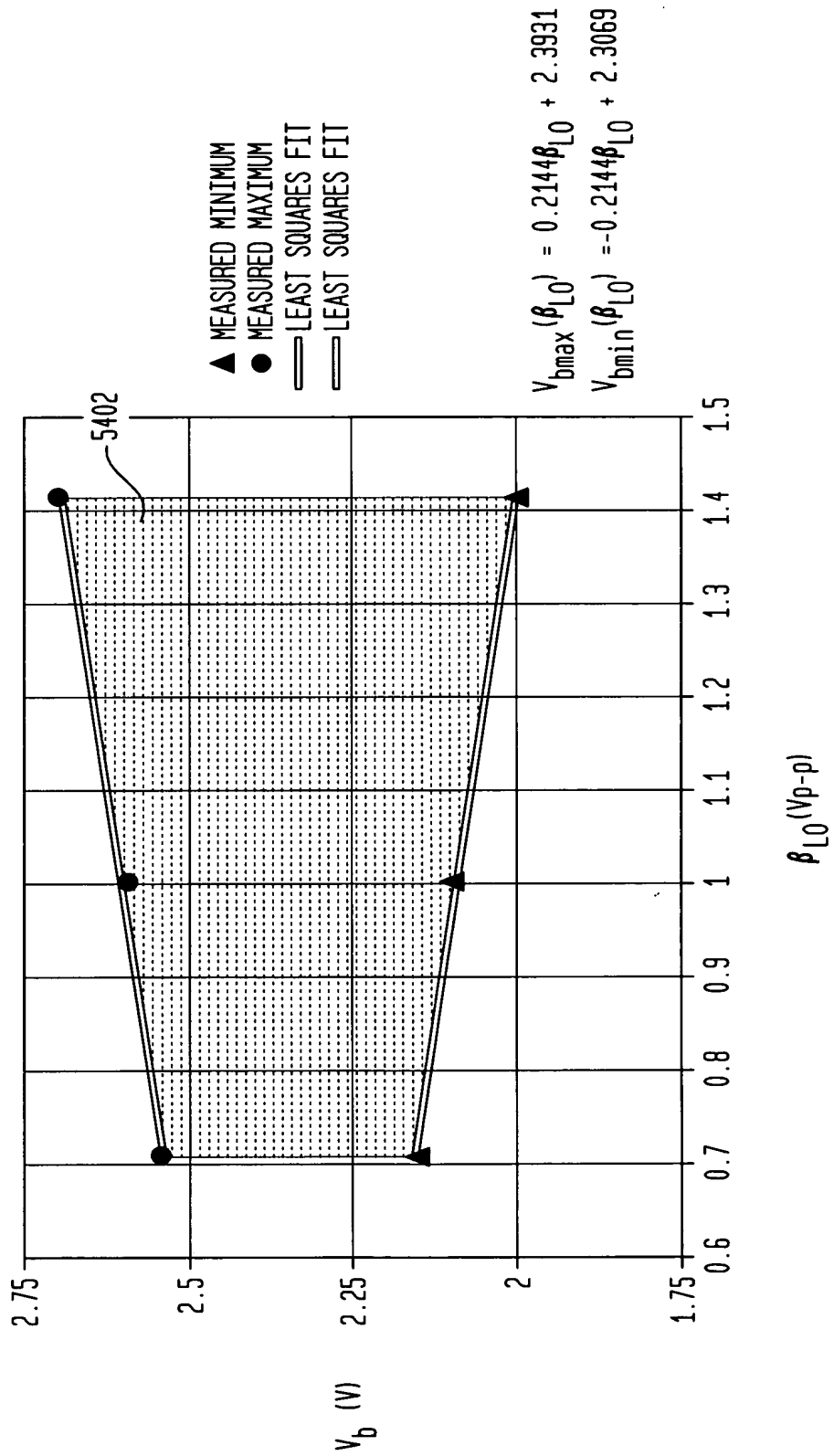


FIG. 55
 A BLOCK DIAGRAM OF A CIRCUIT WHERE THE PHASE OF THE TWO OUTPUTS
 CAN BE ADJUSTED INDEPENDENTLY BY SETTING THE LO BIAS VOLTAGES

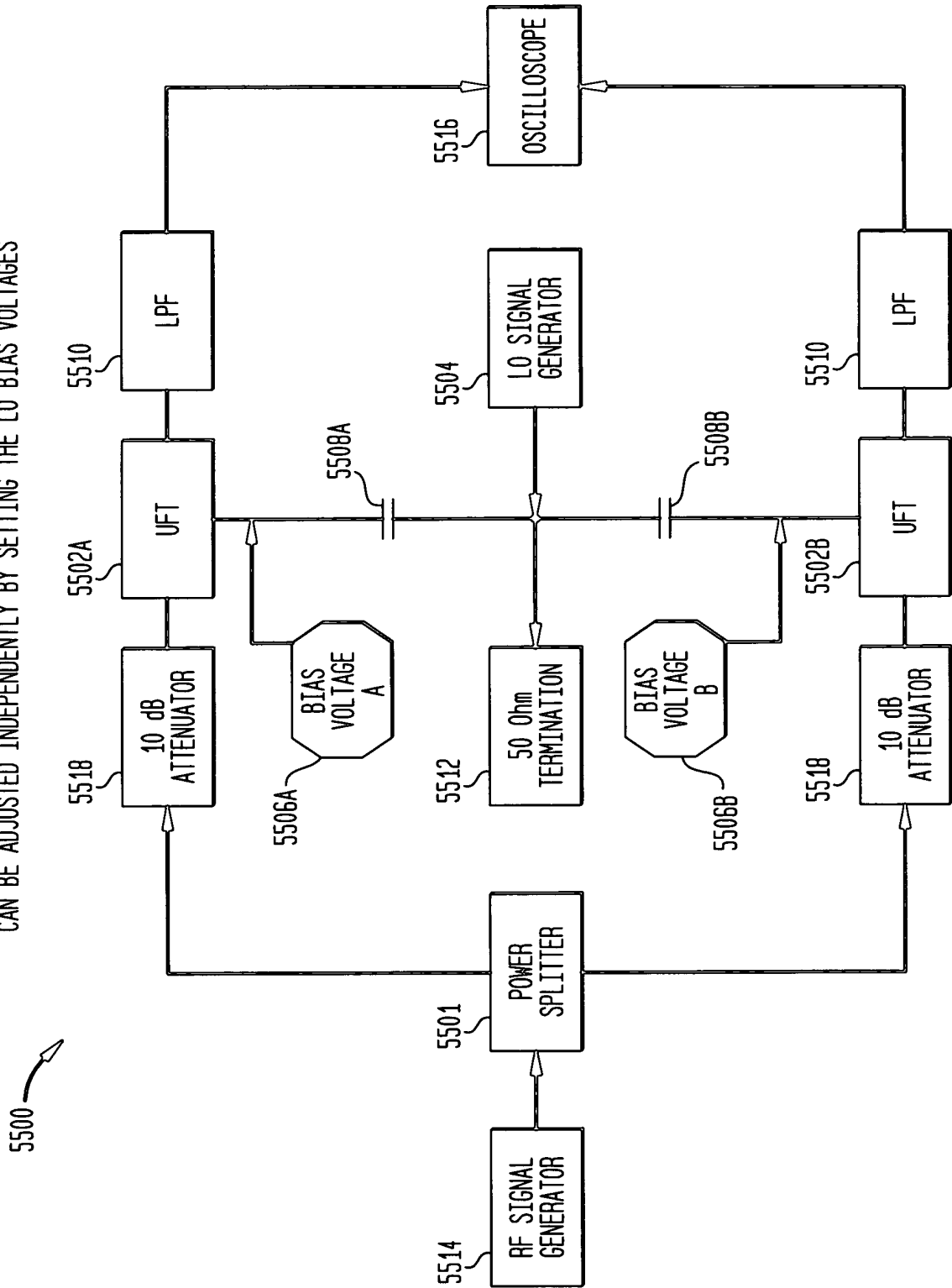
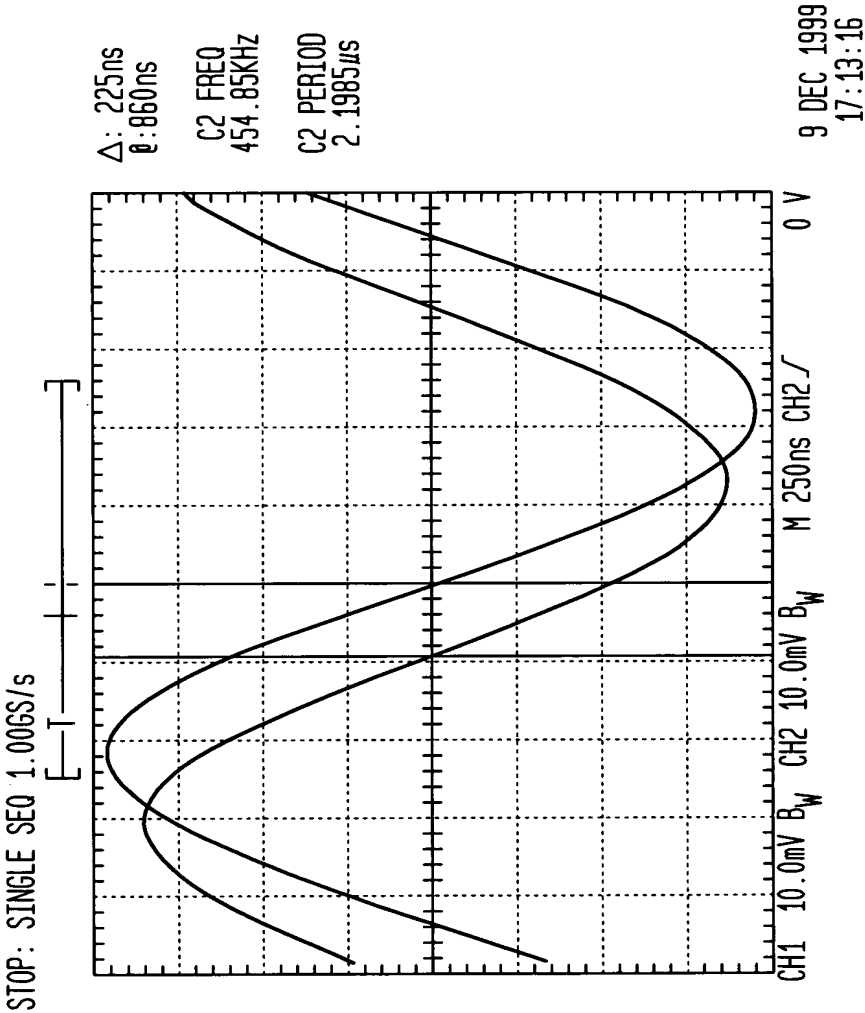


FIG. 56
MEASURED PHASE SHIFT FOR THE DESIGN EXAMPLE



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FIG. 57A

MEASURED AND APPROXIMATED UFT PHASE FUNCTION
 FOR p-p LO AMPLITUDE OF 7 dBm IN TO 50 Ohms

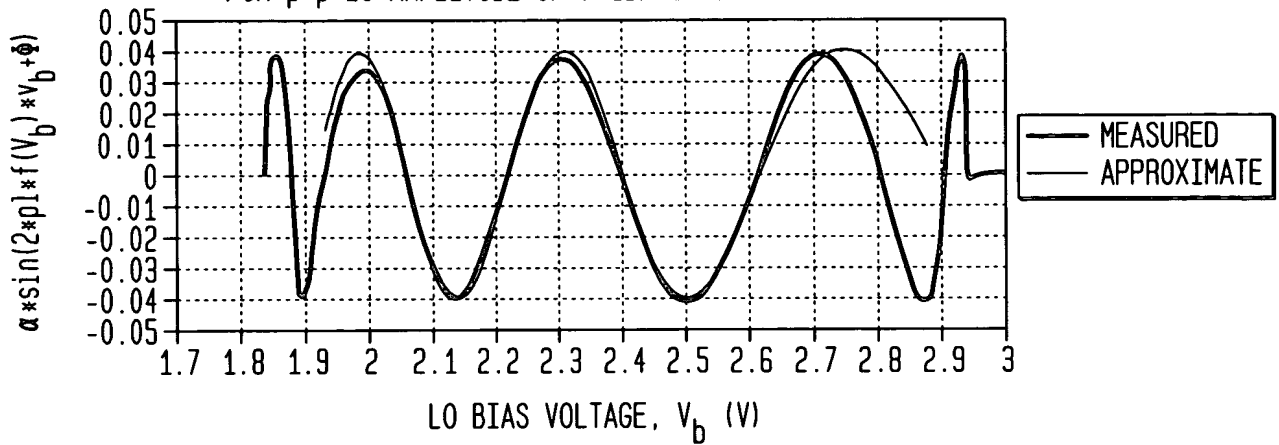


FIG. 57B

MEASURED AND APPROXIMATED UFT PHASE FUNCTION
 FOR p-p LO AMPLITUDE OF 4 dBm IN TO 50 Ohms

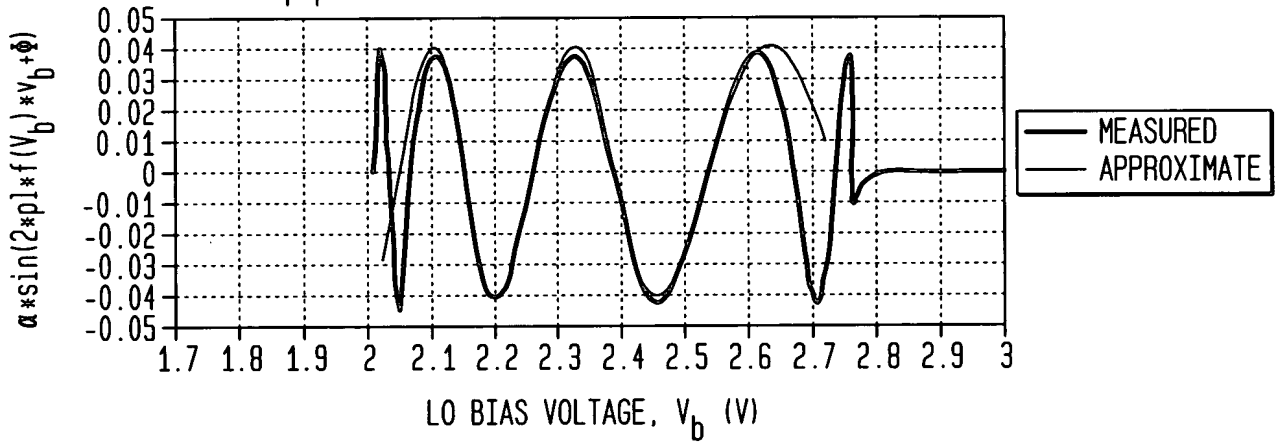


FIG. 57C

MEASURED AND APPROXIMATED UFT PHASE FUNCTION
 FOR p-p LO AMPLITUDE OF 1 dBm IN TO 50 Ohms

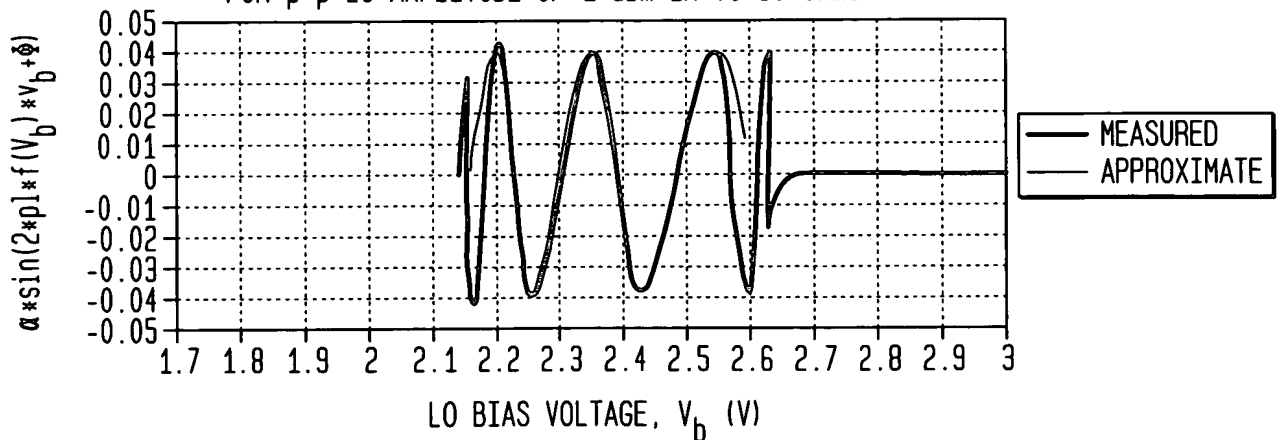


FIG. 58A

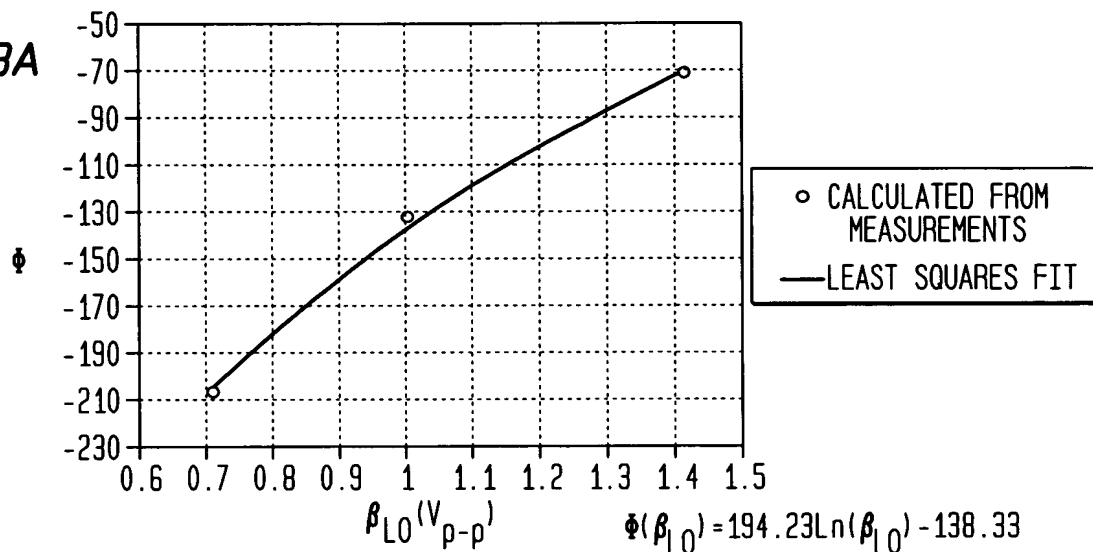


FIG. 58B

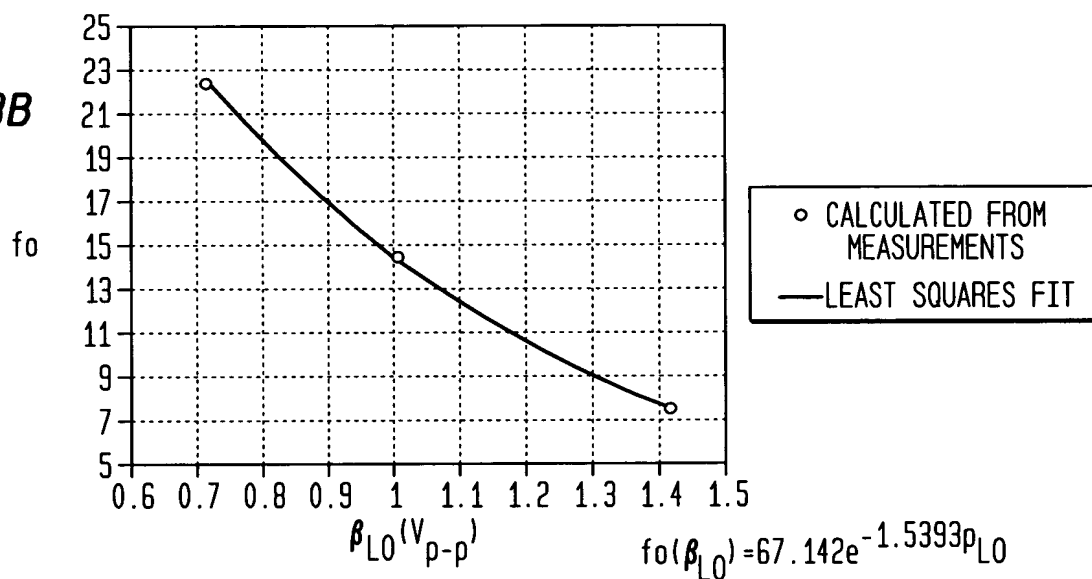
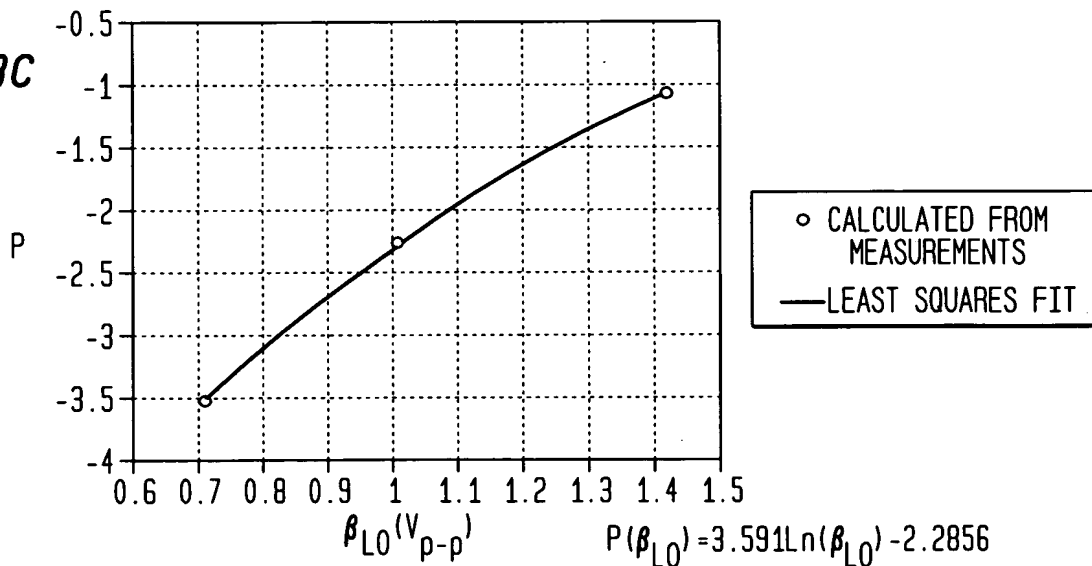
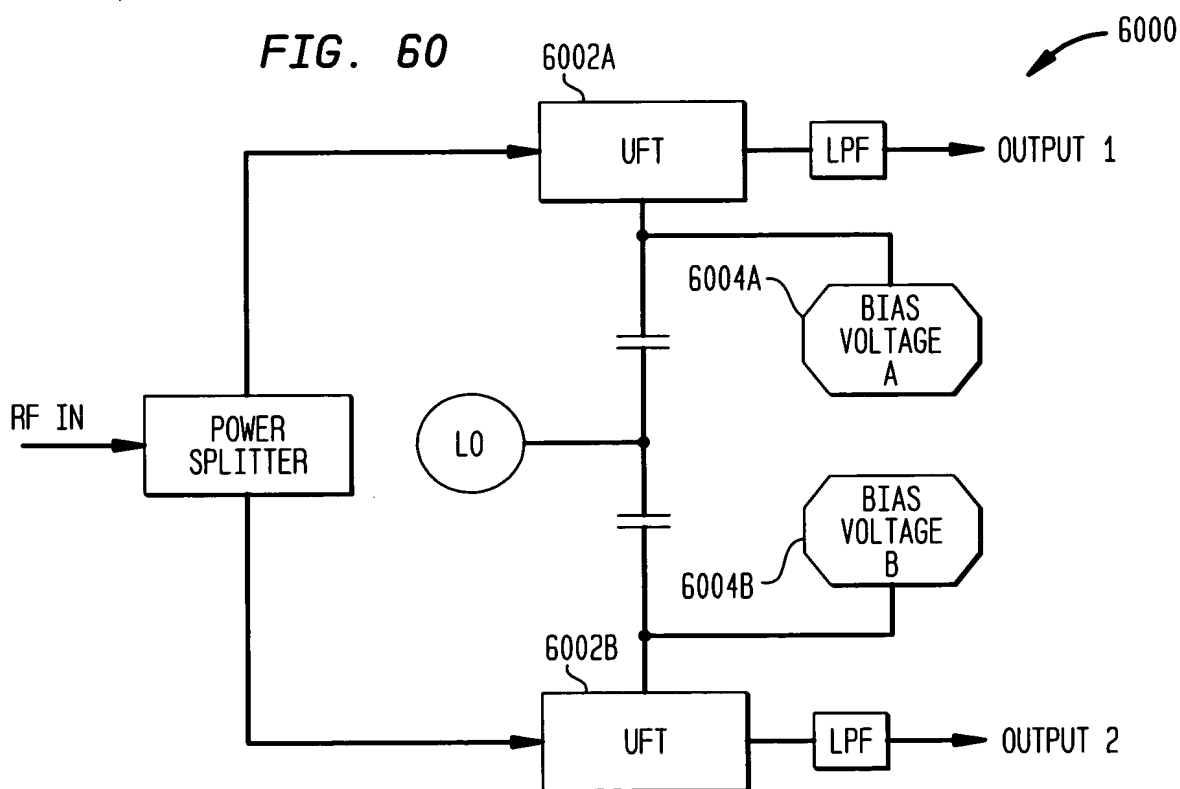
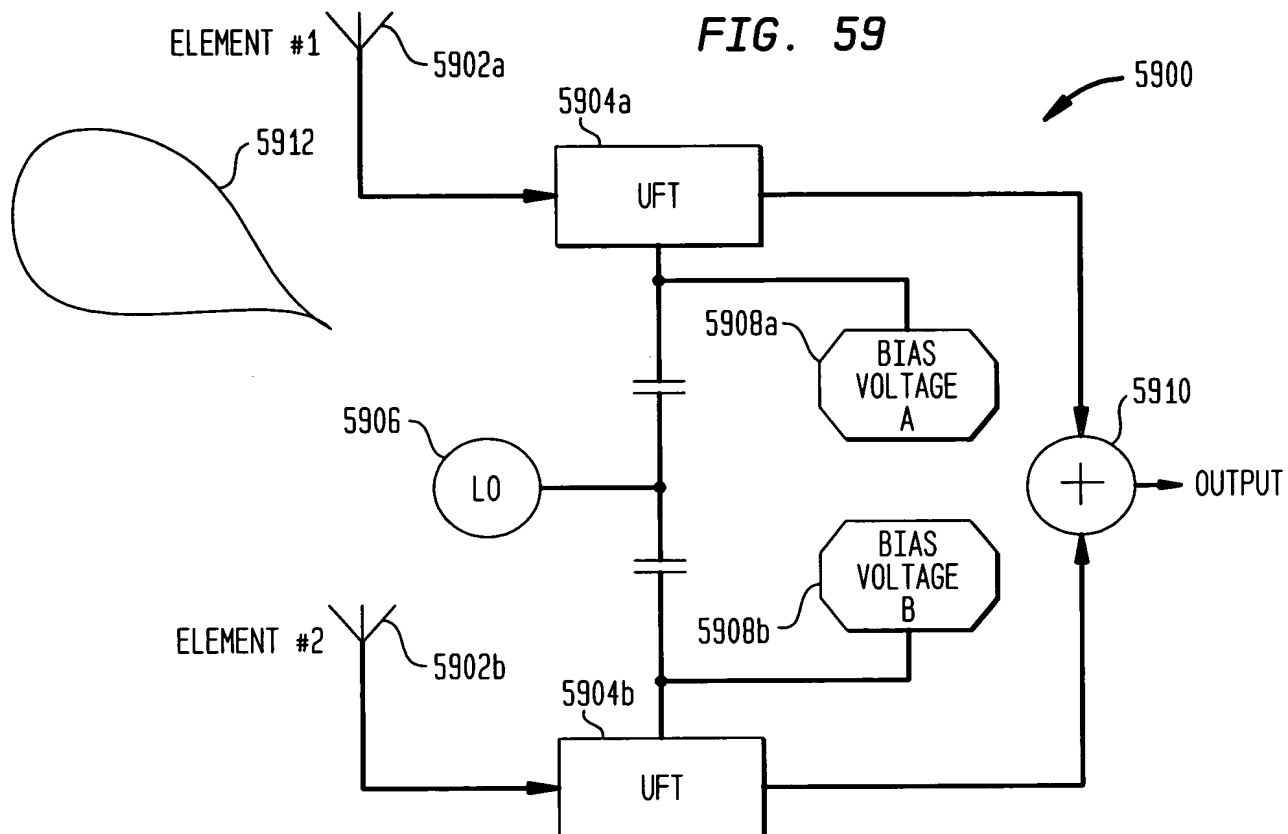


FIG. 58C





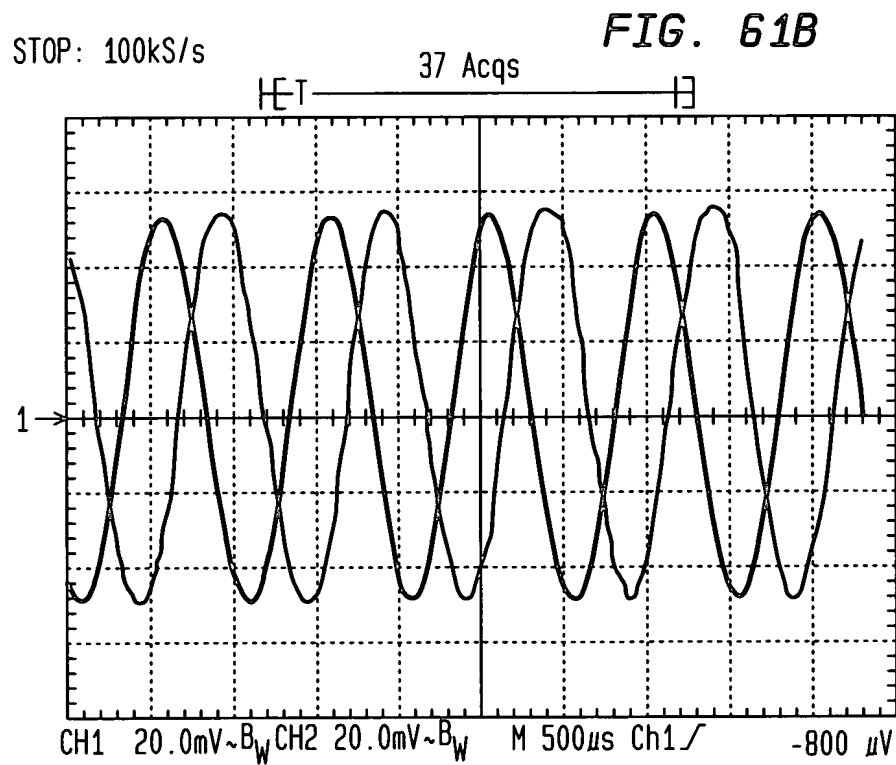
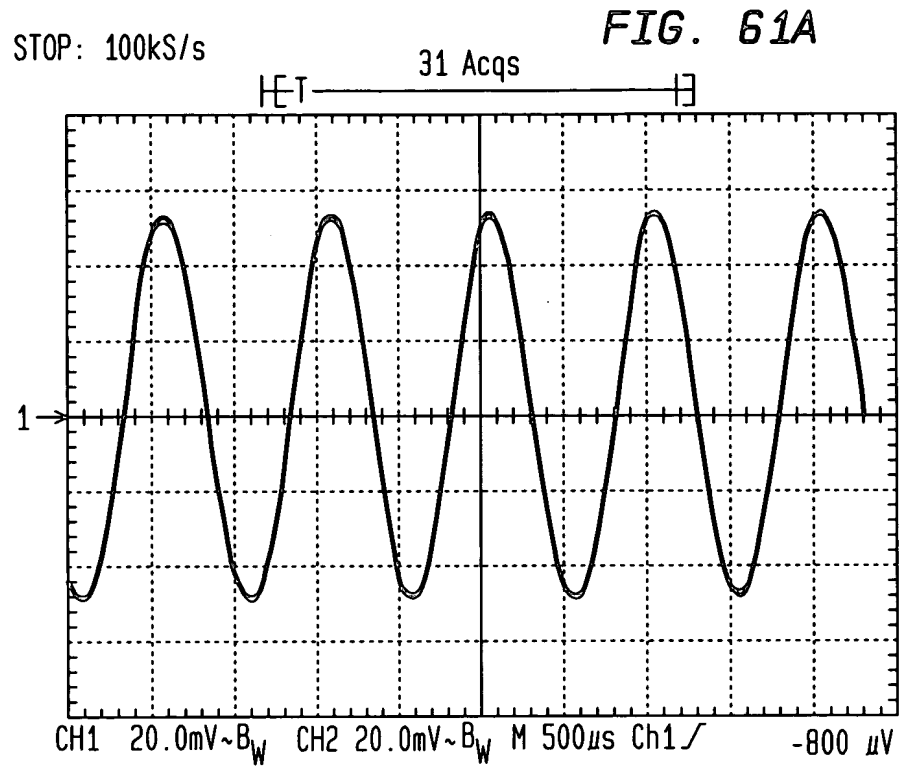


FIG. 62

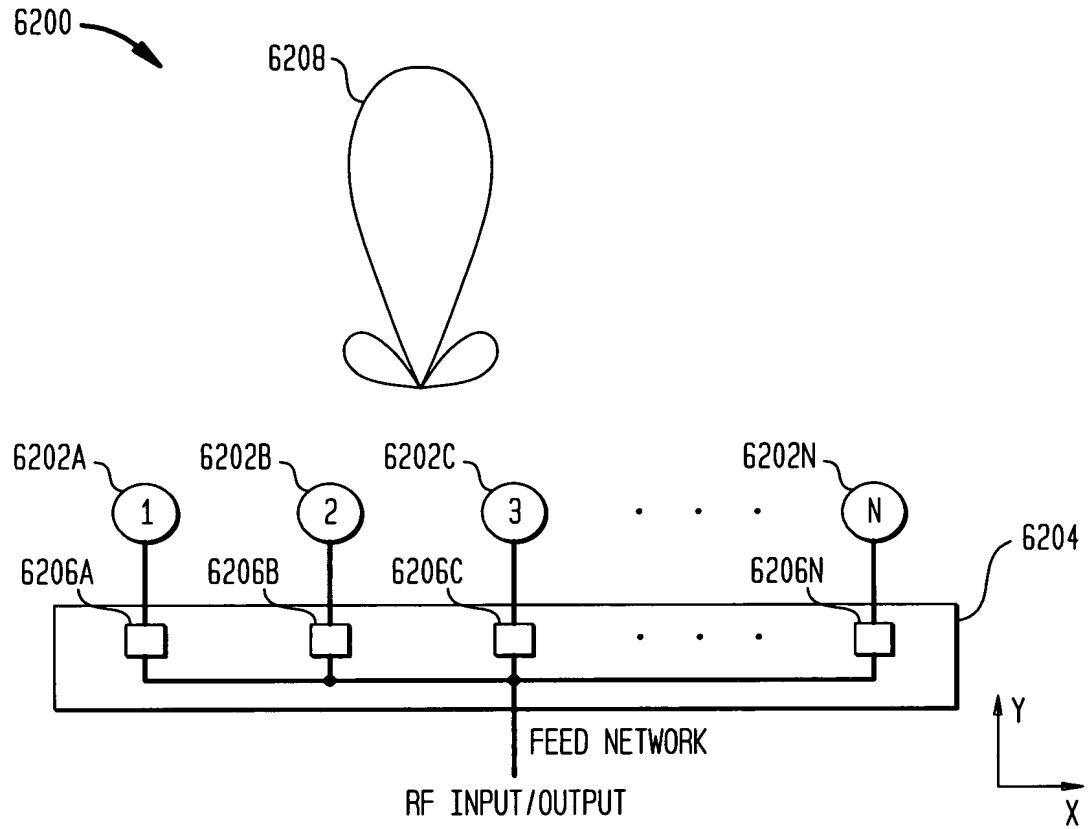


FIG. 63A

LINEAR PHASED ARRAY USING UFT TO STEER THE MAIN BEAM

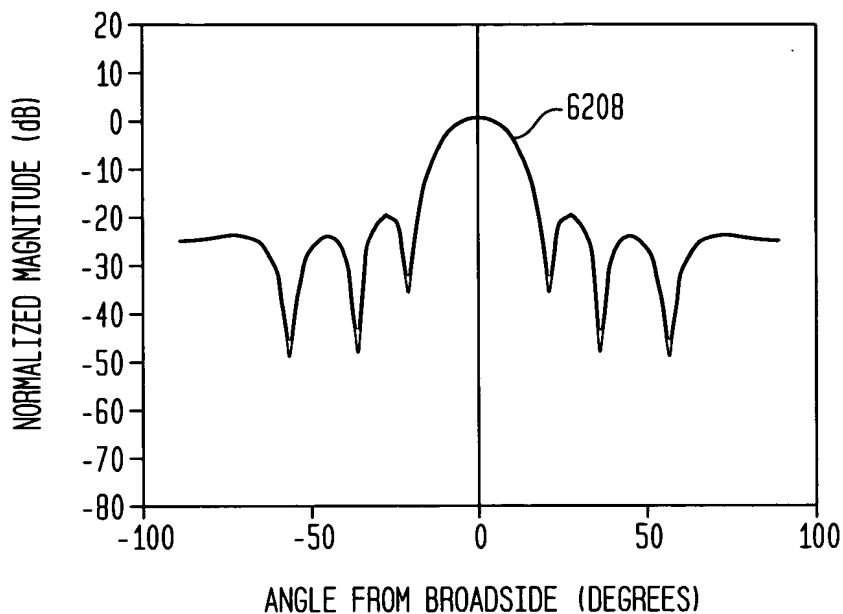
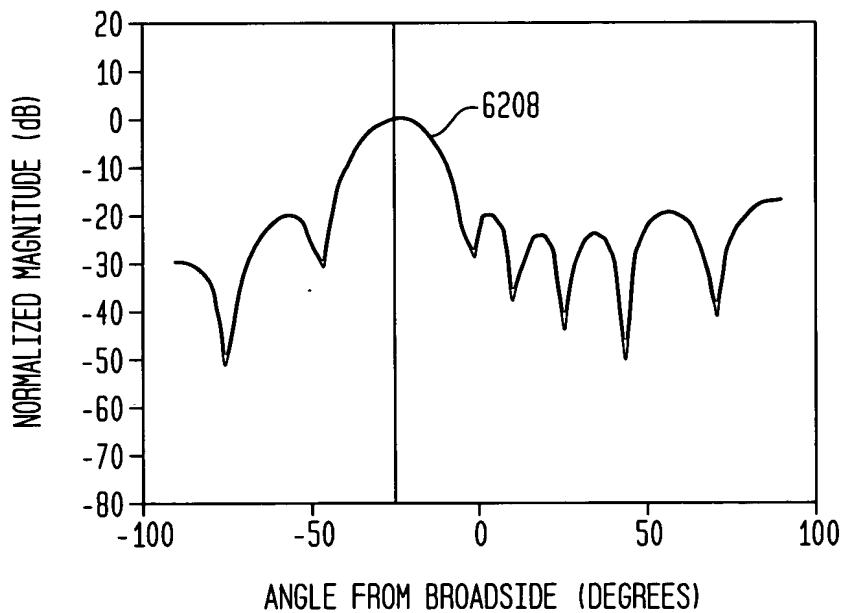


FIG. 63B

LINEAR PHASED ARRAY USING UFT TO STEER THE MAIN BEAM



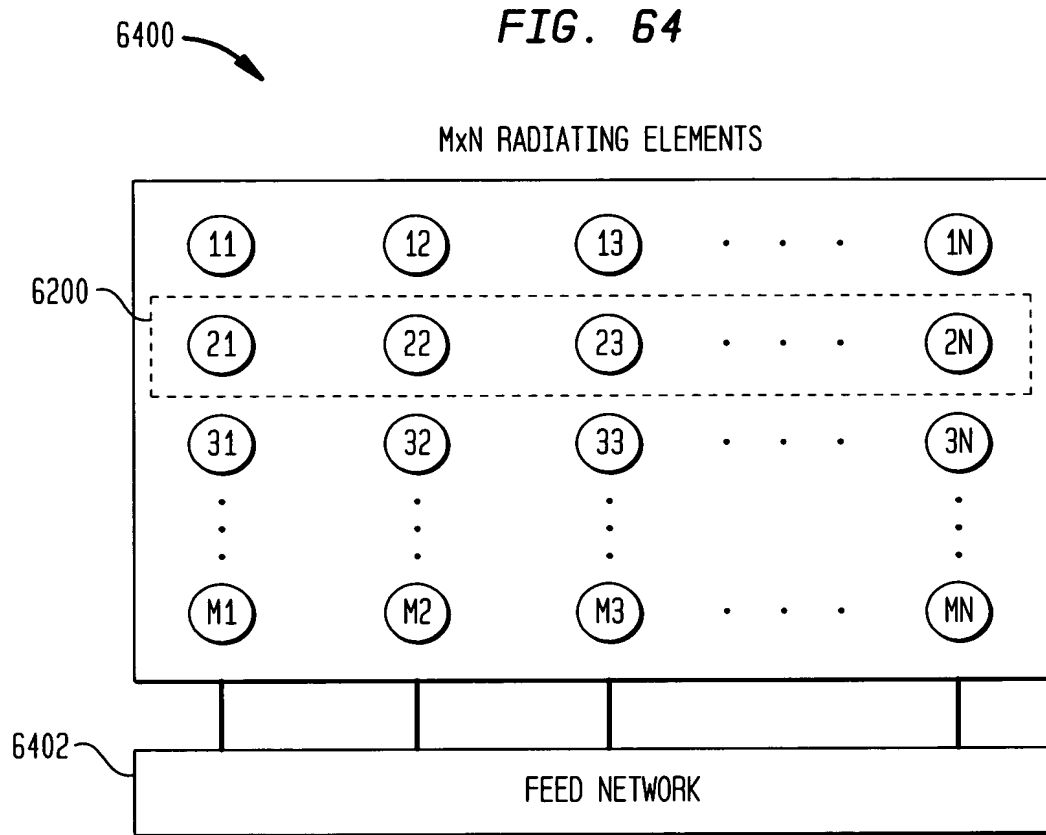


FIG. 65A

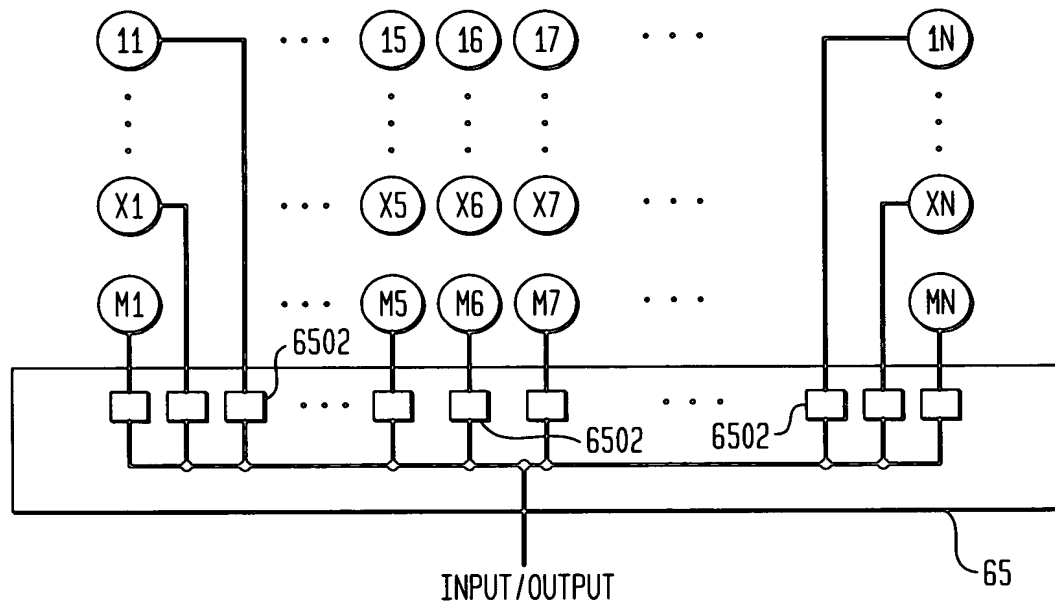


FIG. 65B

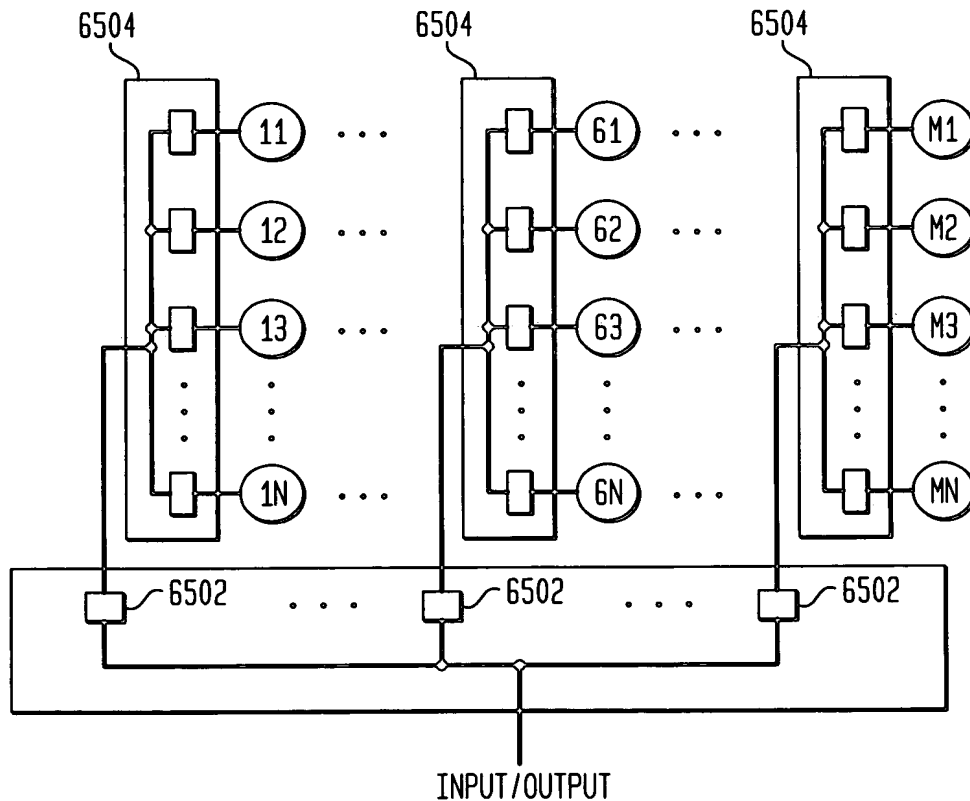


FIG. 66A

2-D PHASED ARRAY USING UFTs TO STEER THE MAIN BEAM

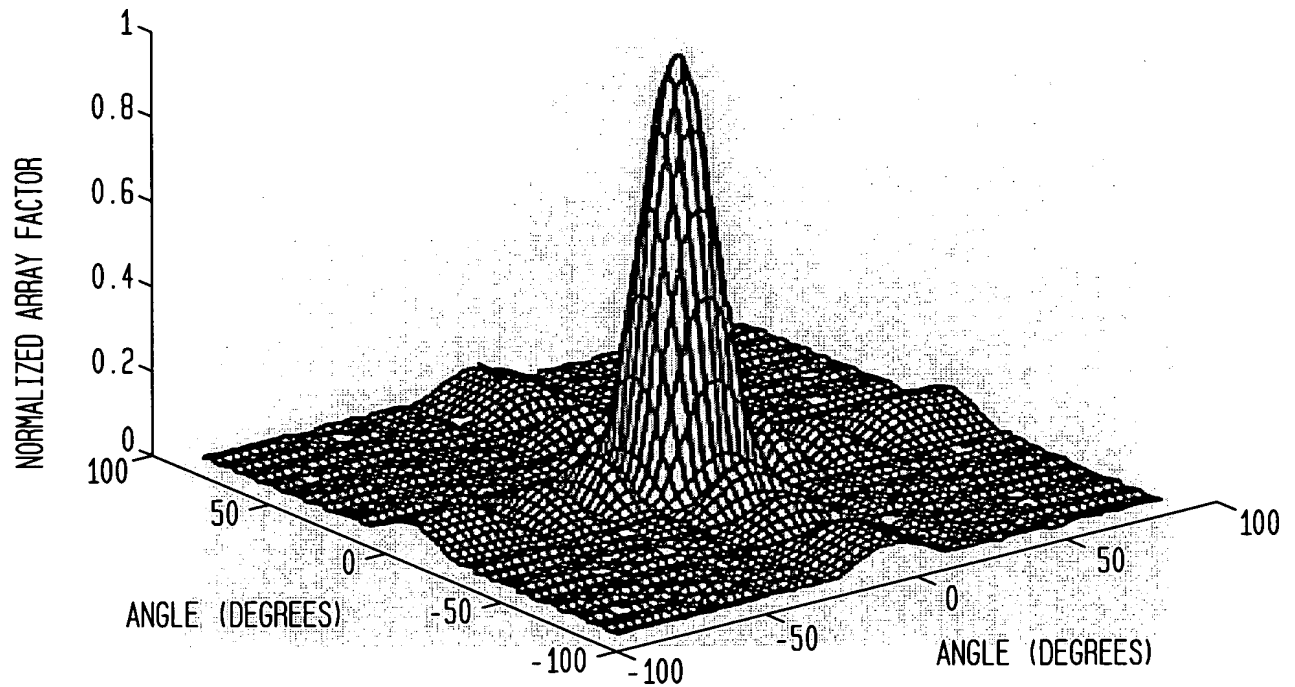


FIG. 66B

2-D PHASED ARRAY USING UFTs TO STEER THE MAIN BEAM

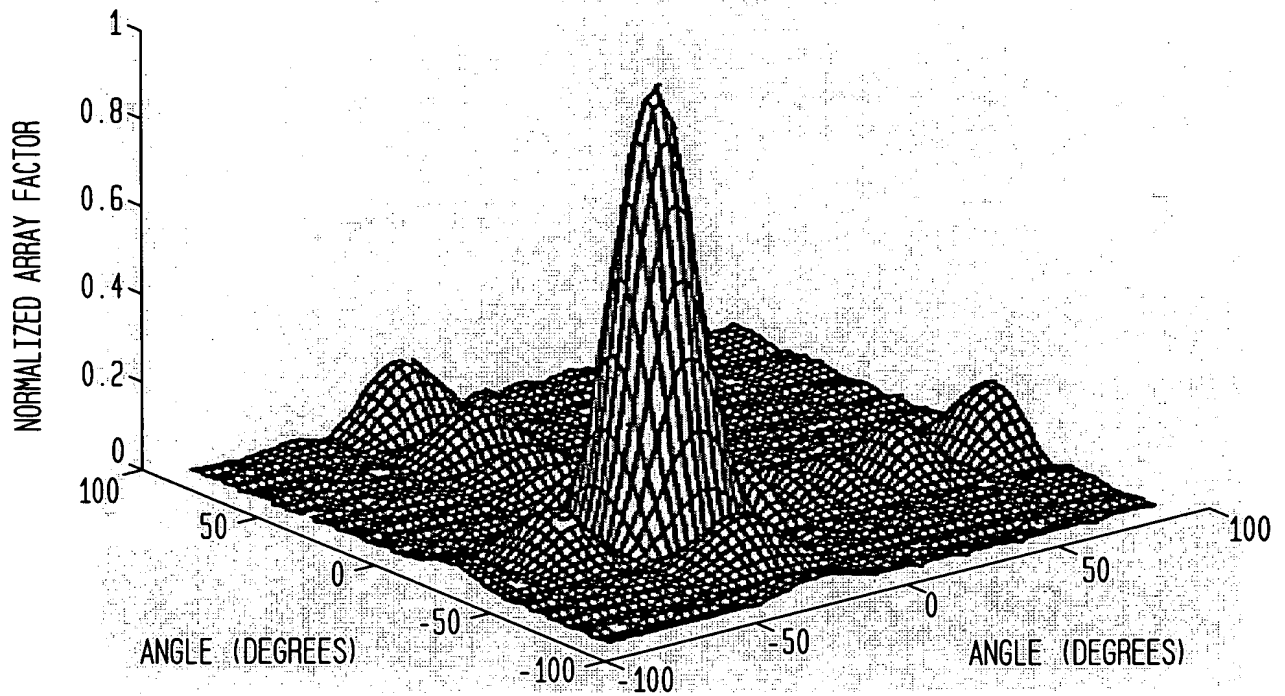


FIG. 67A

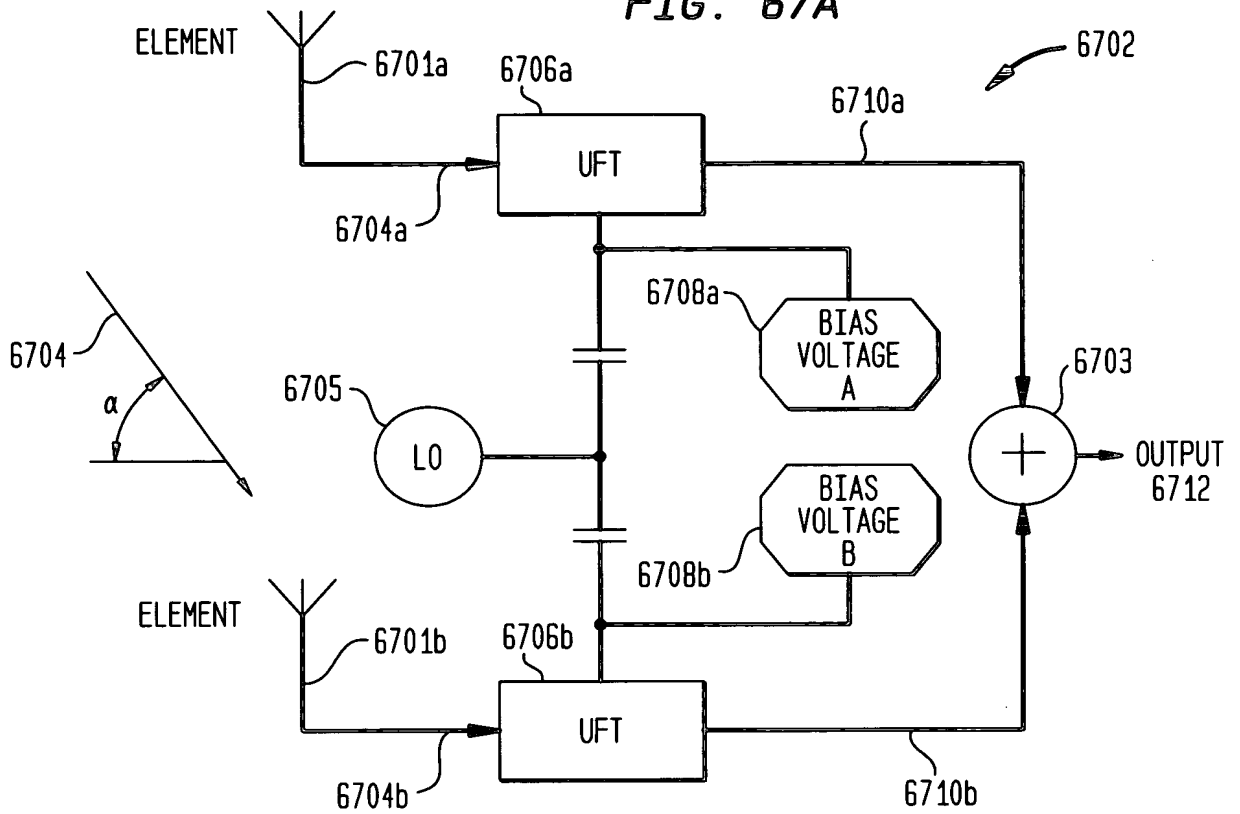


FIG. 67B

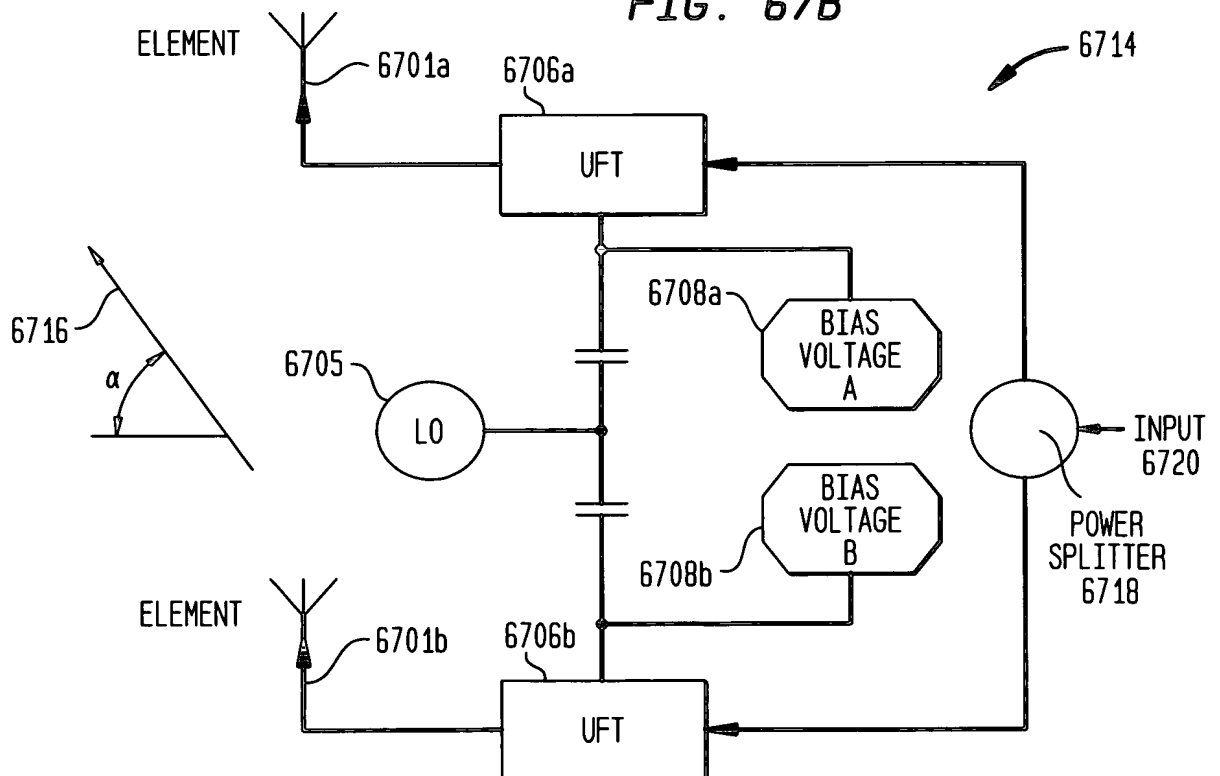


FIG. 67C

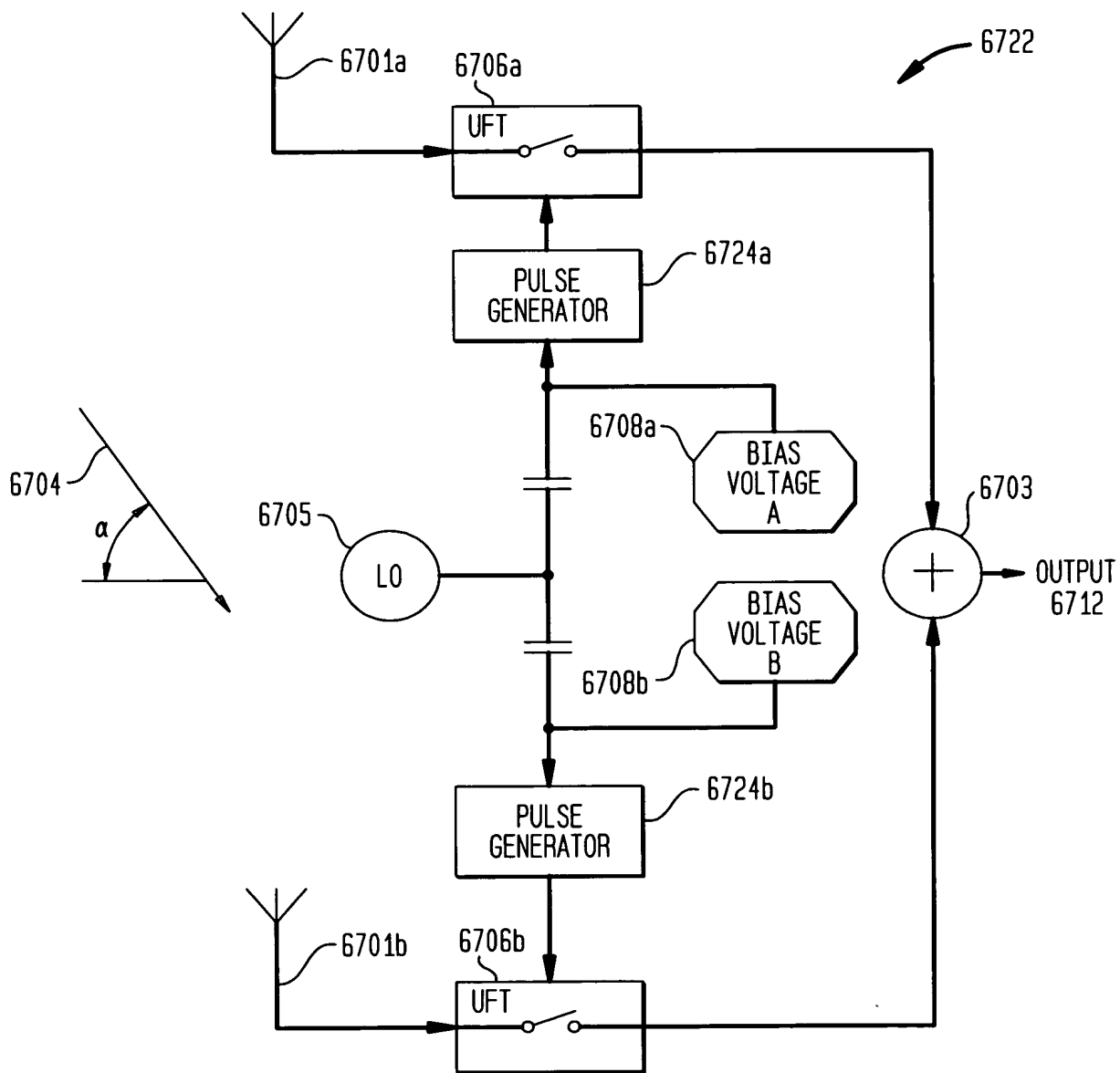


FIG. 67D

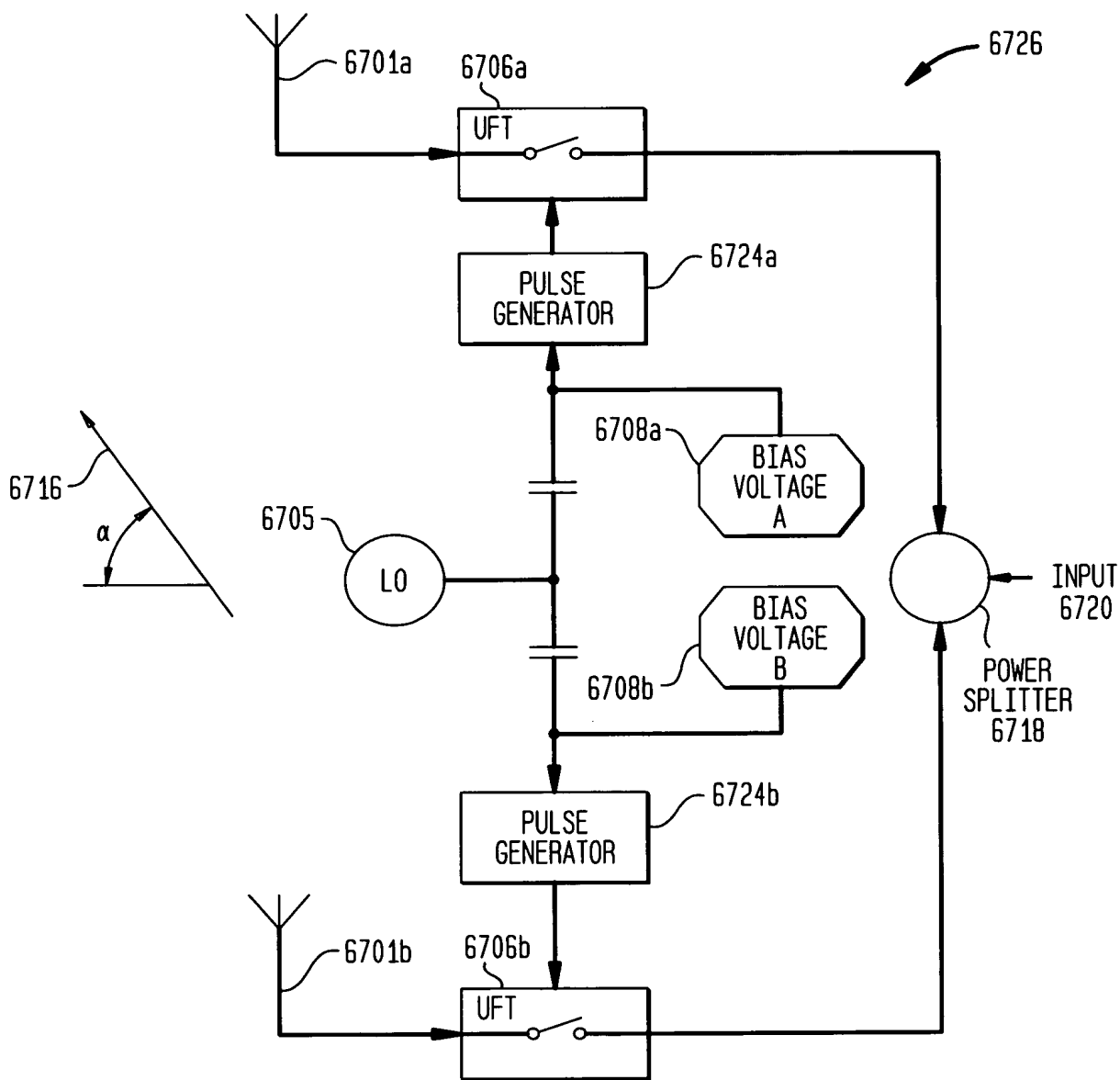


FIG. 68A

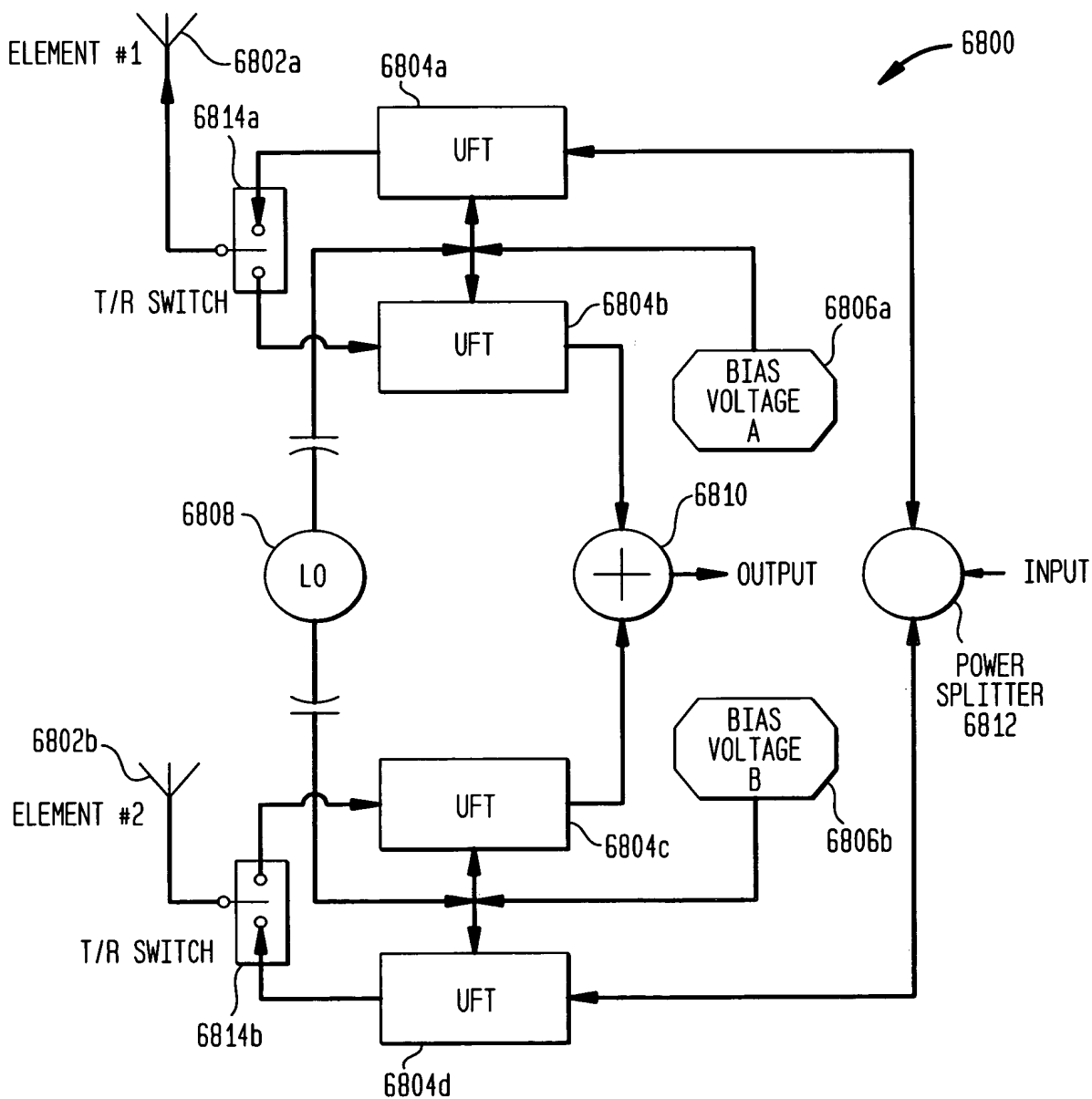


FIG. 68B

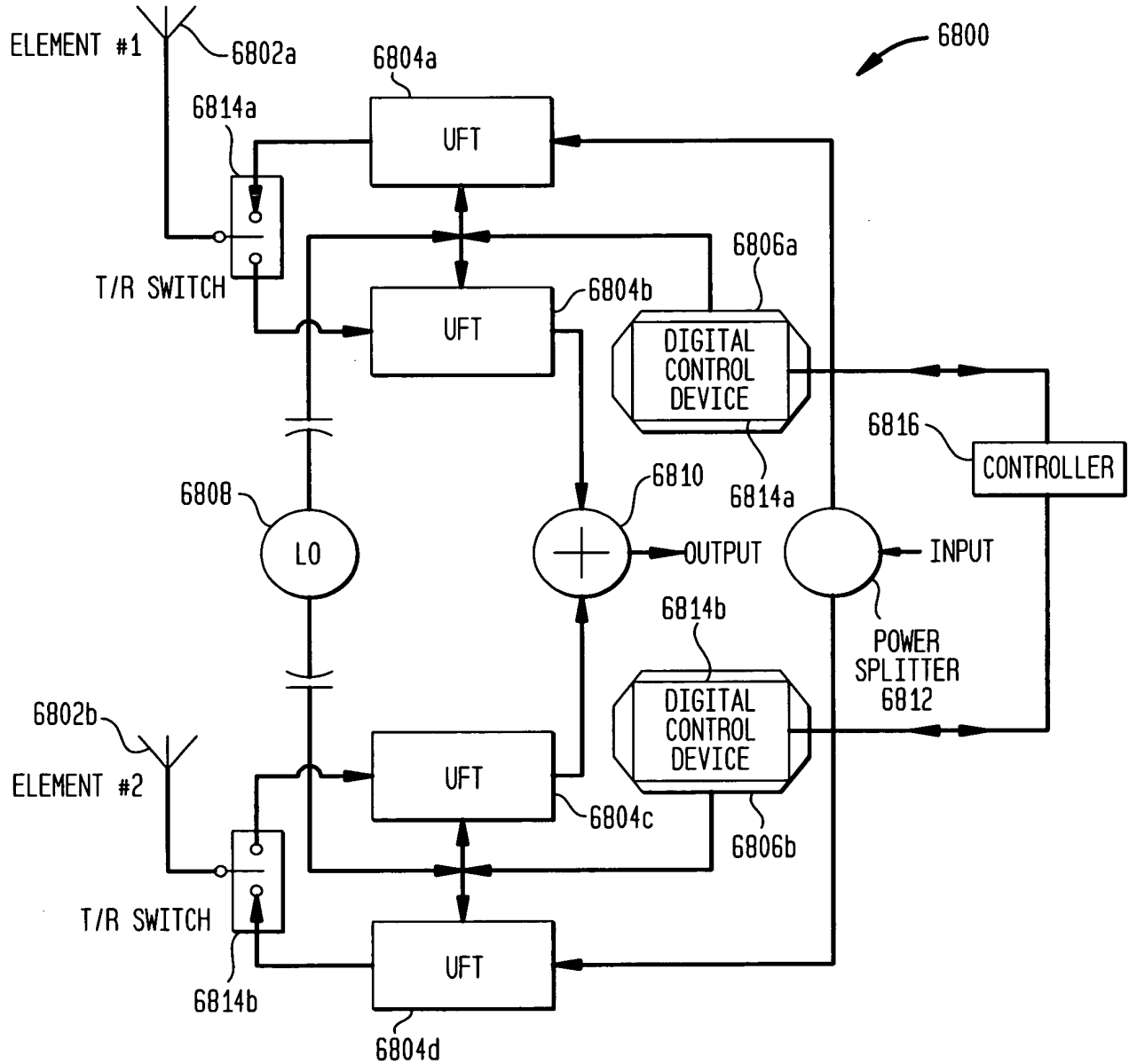


FIG. 68C

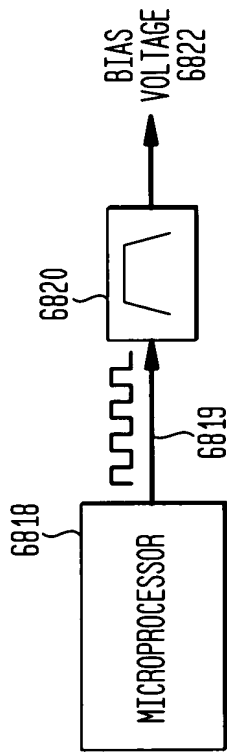
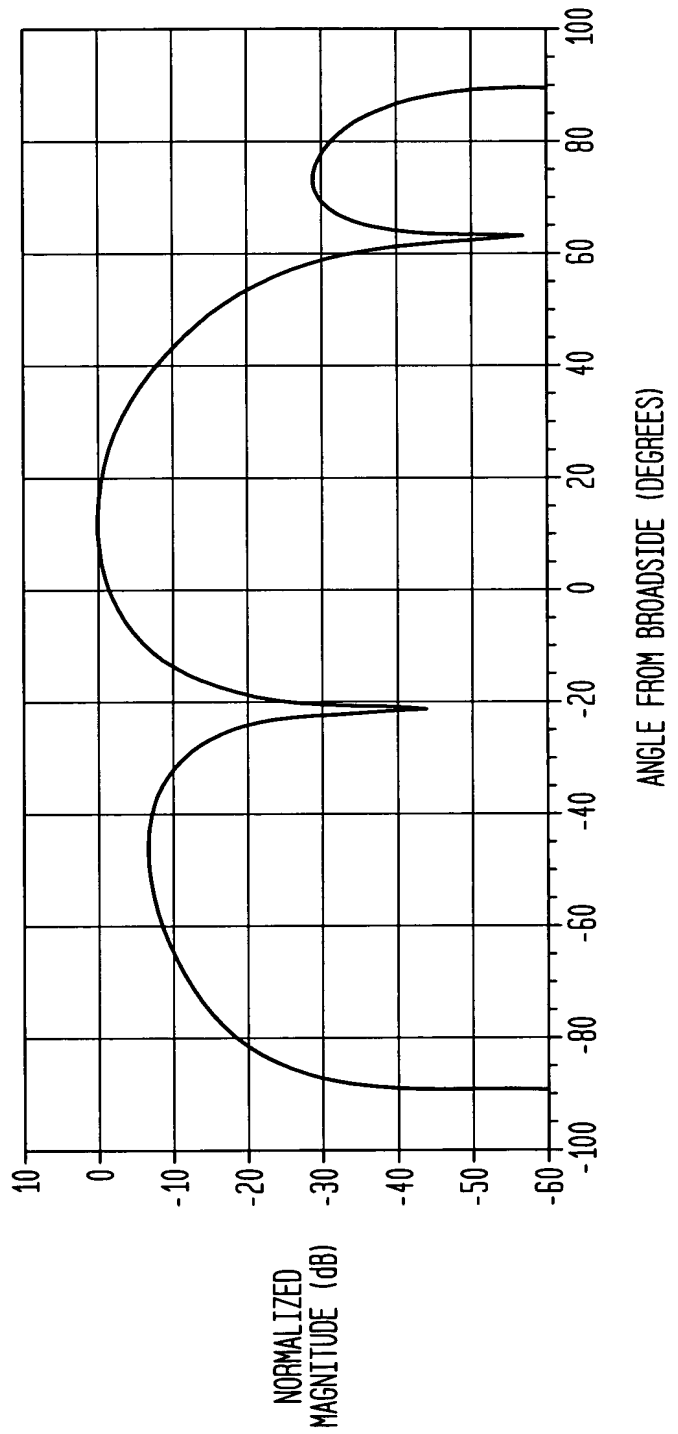


FIG. 69

RADIATION PATTERN FOR A UFT BASED, TWO ELEMENT PHASED ARRAY
 15 DEGREE MAIN BEAM ANGLE, -20 DEGREE NULL



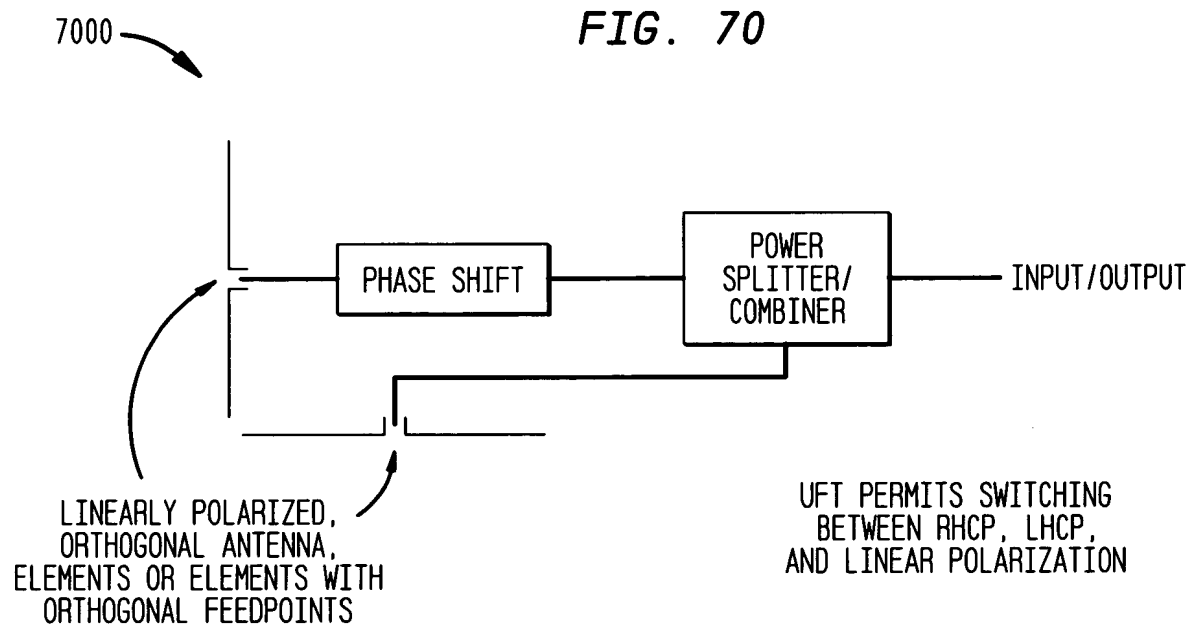


FIG. 71

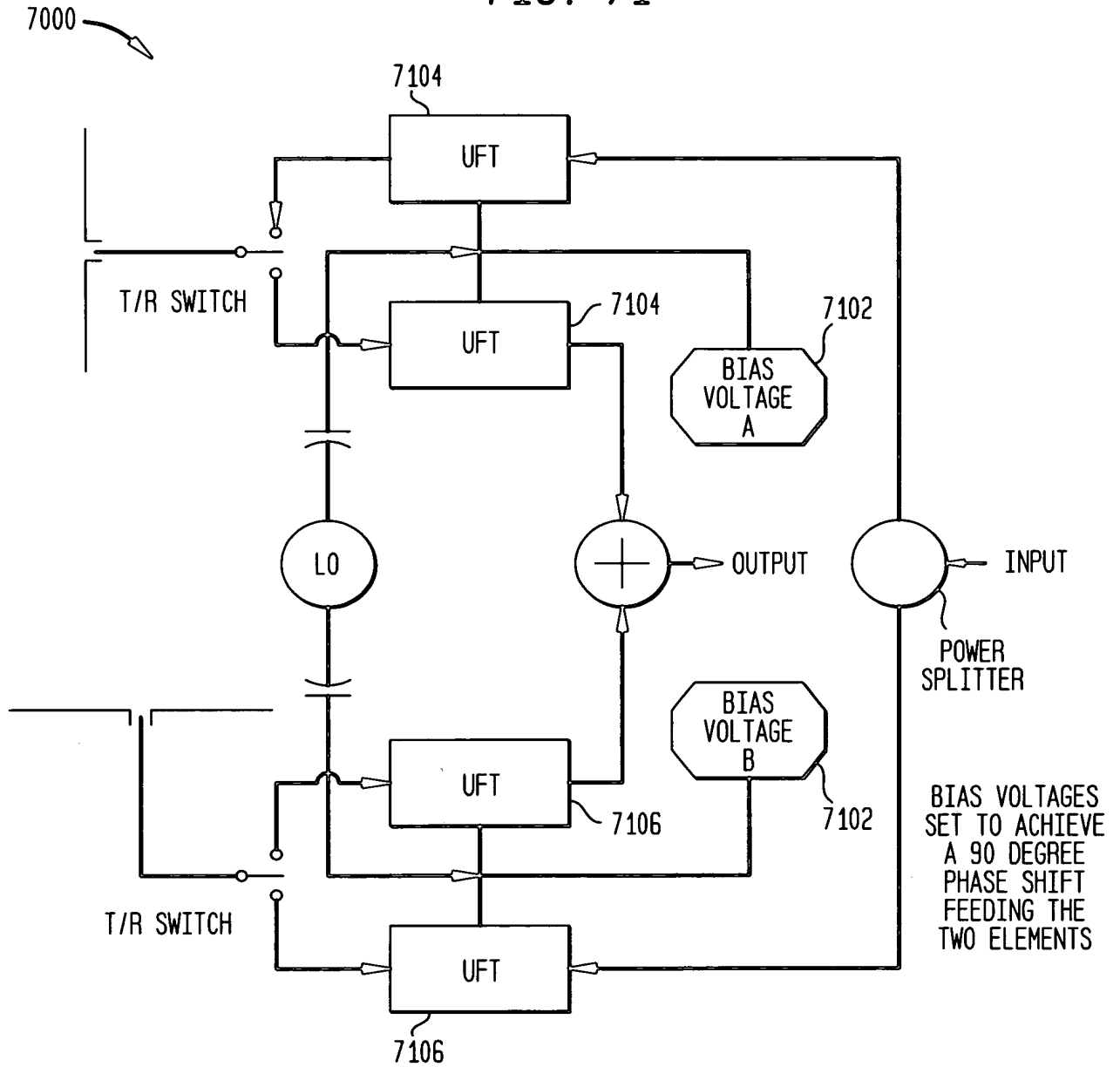


FIG. 72

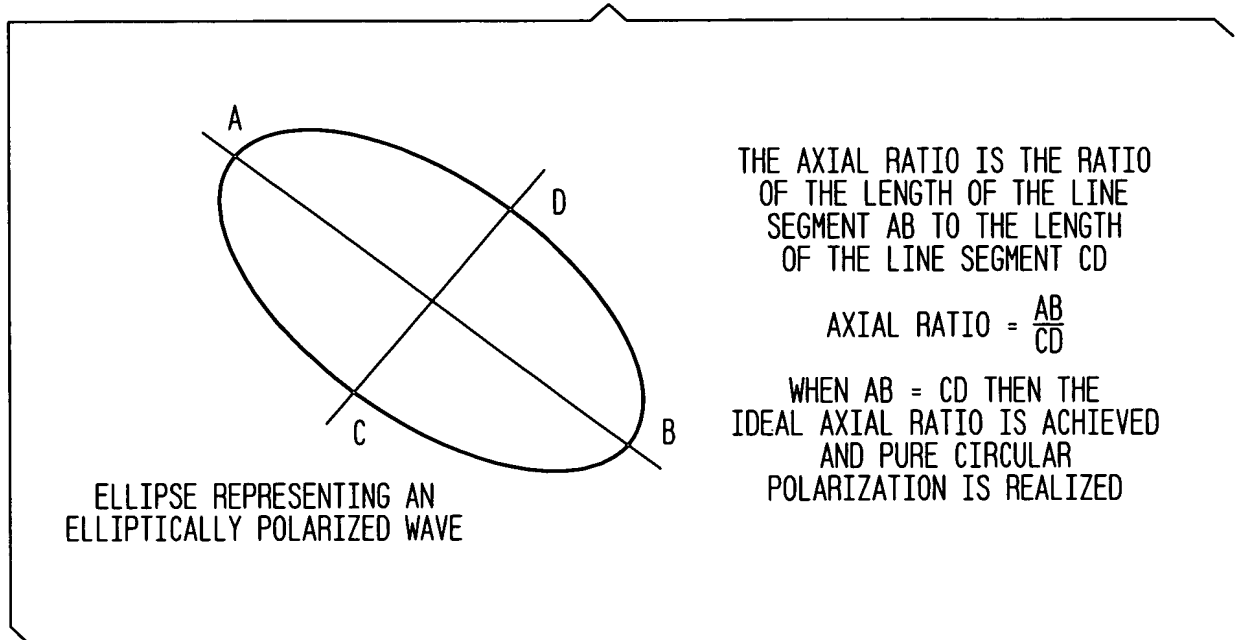


FIG. 73

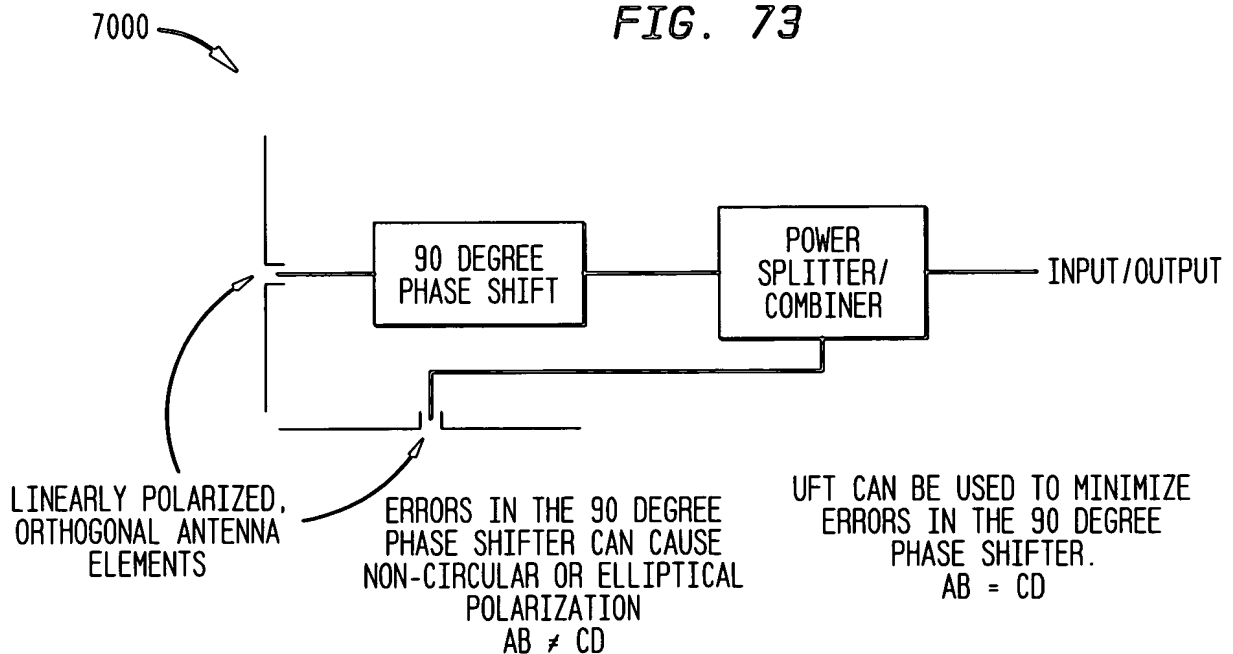
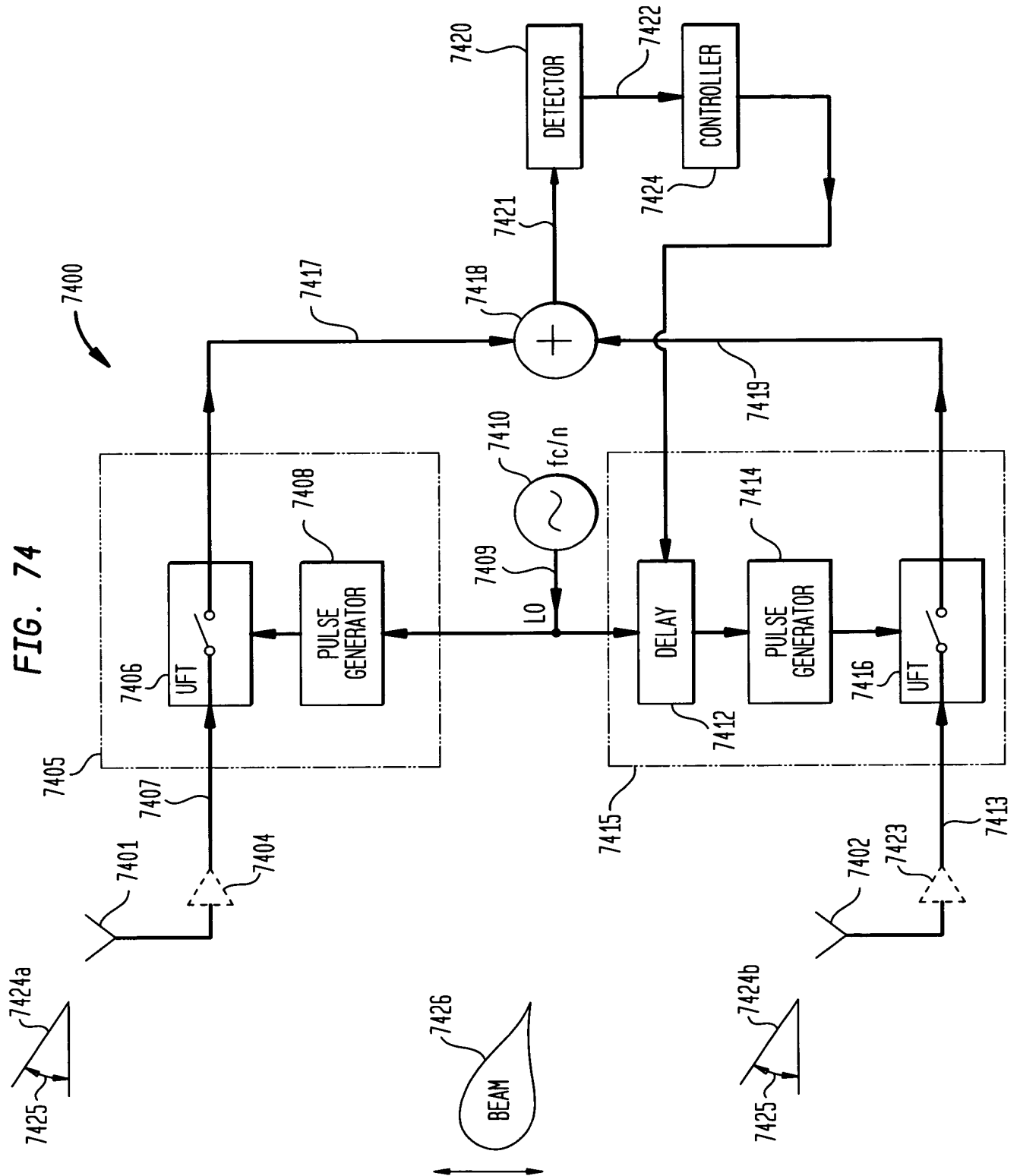


FIG. 74



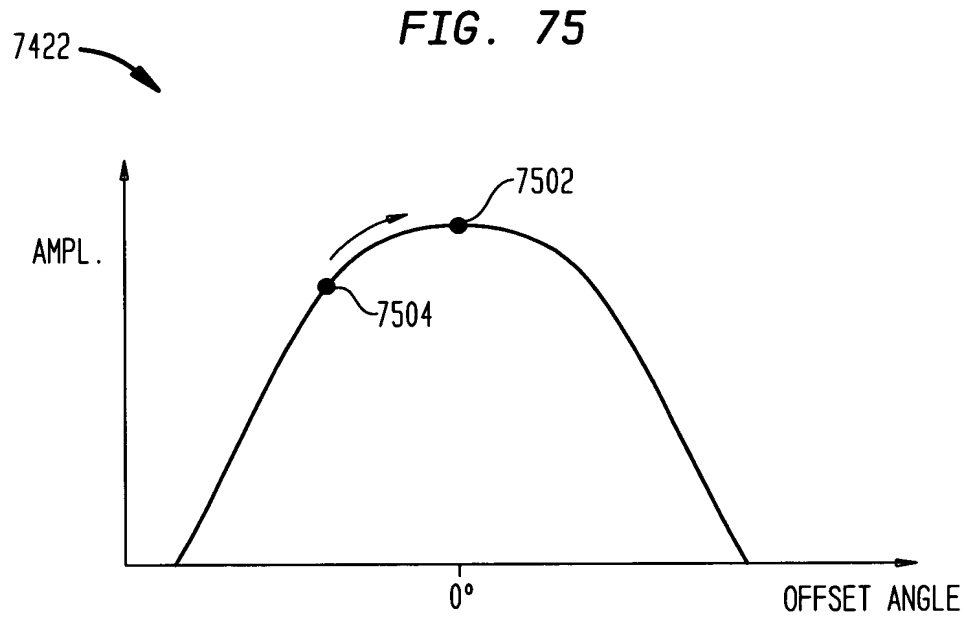


FIG. 76

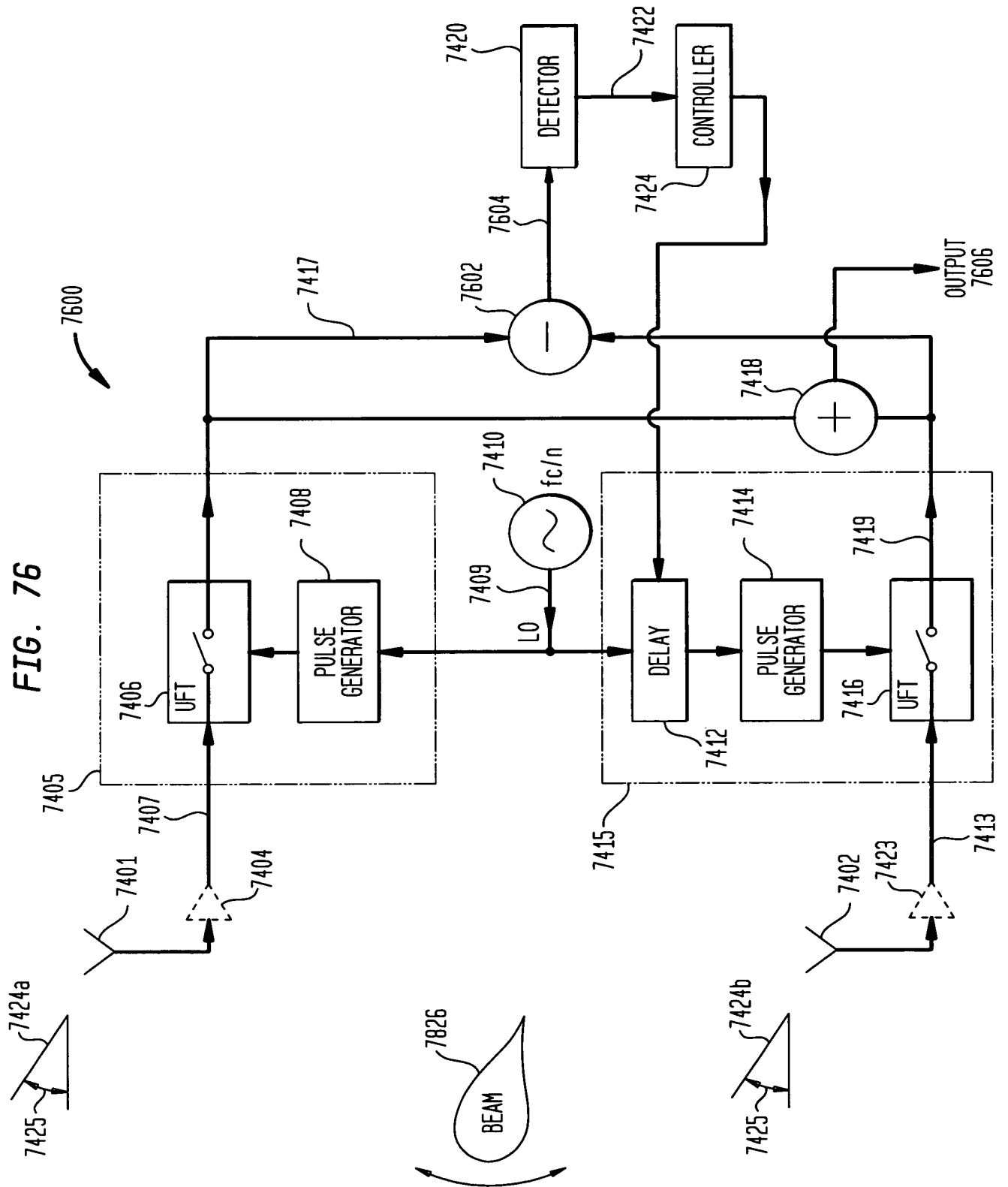


FIG. 77

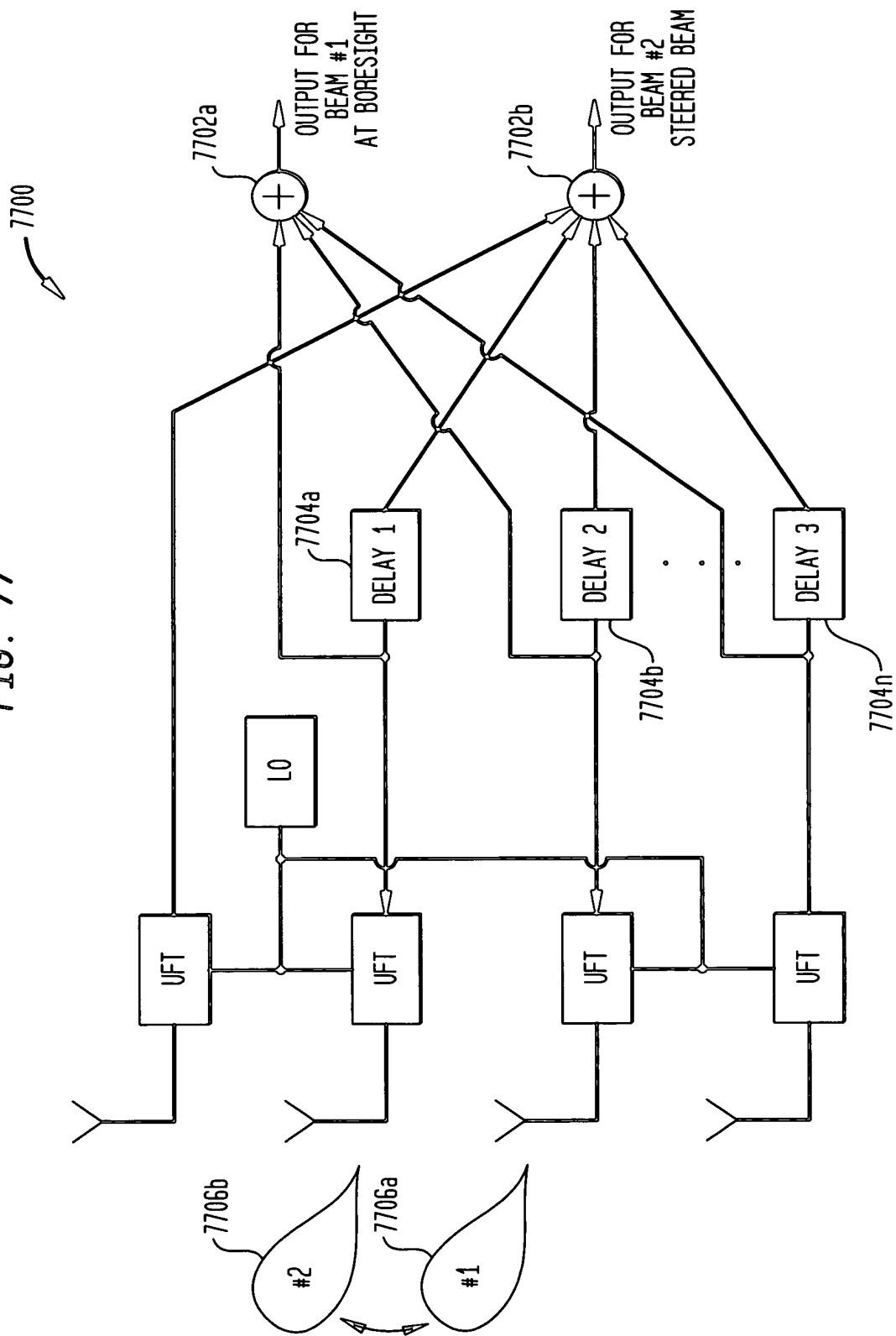


FIG. 78A

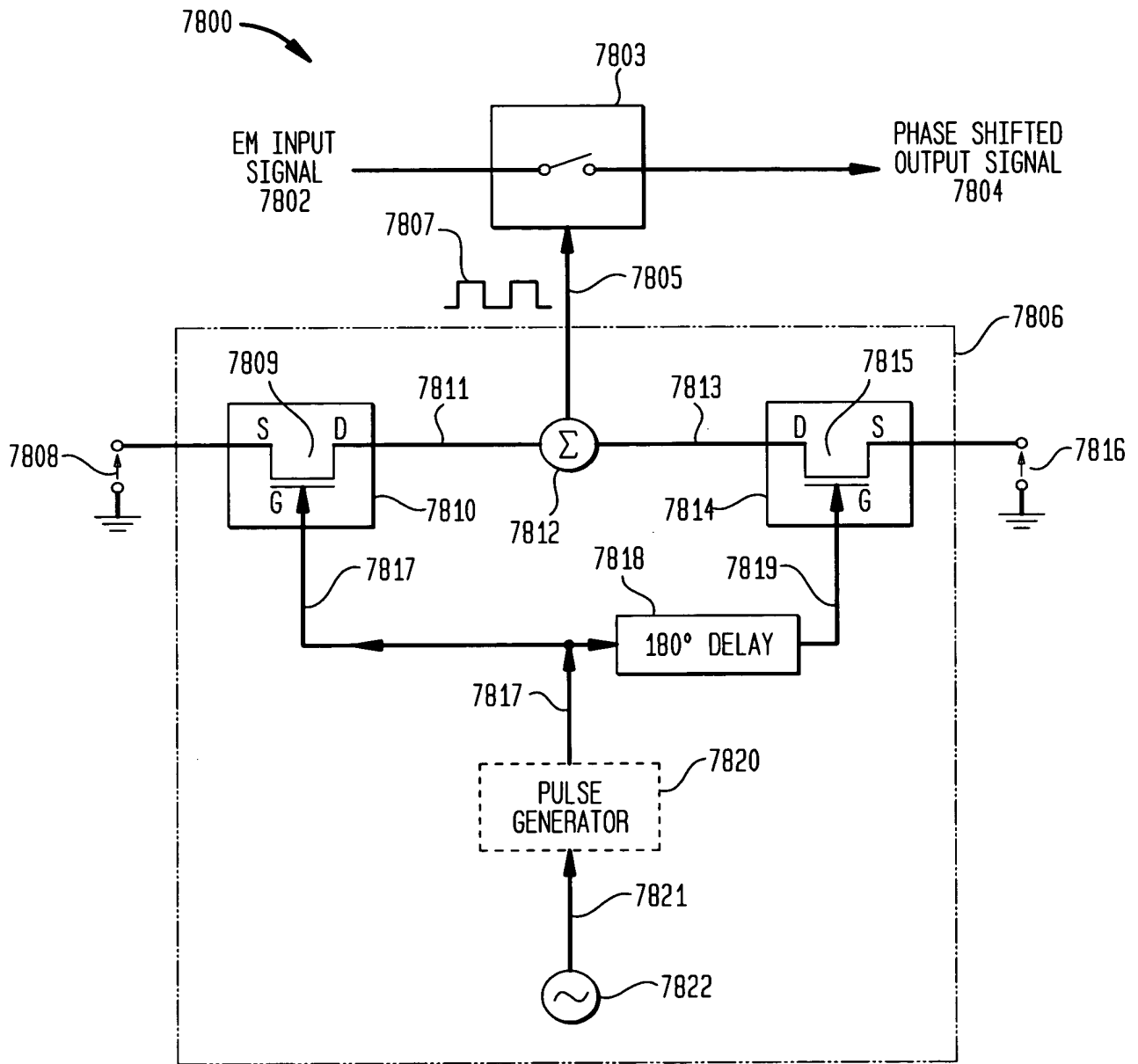


FIG. 78B

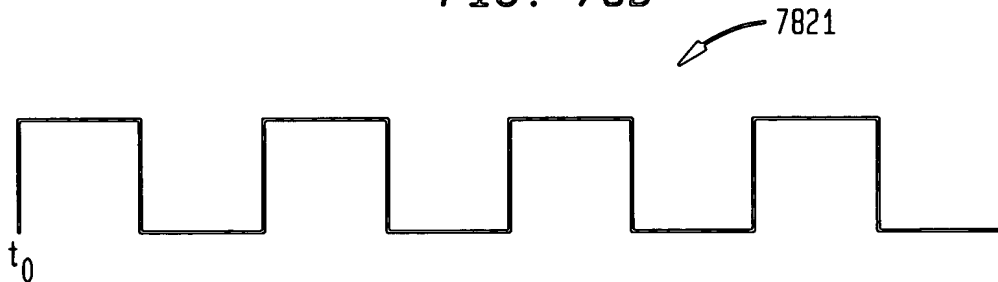


FIG. 78C

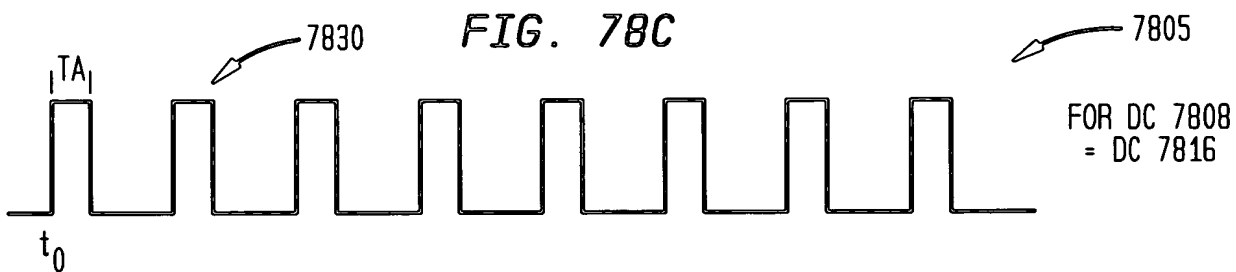


FIG. 78D

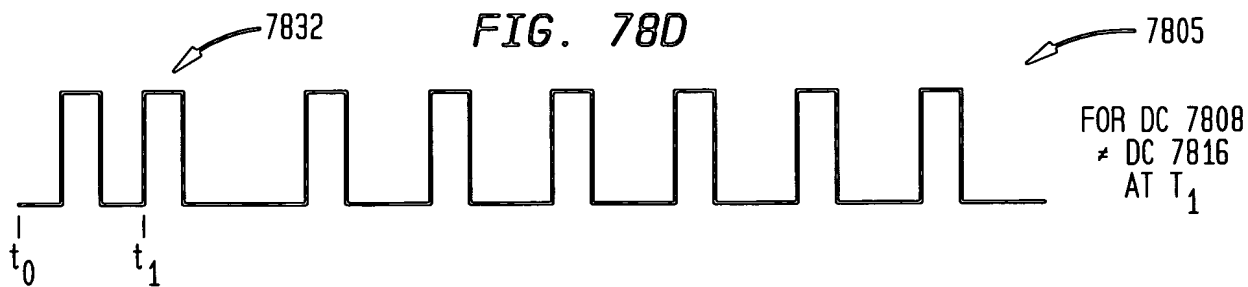


FIG. 79

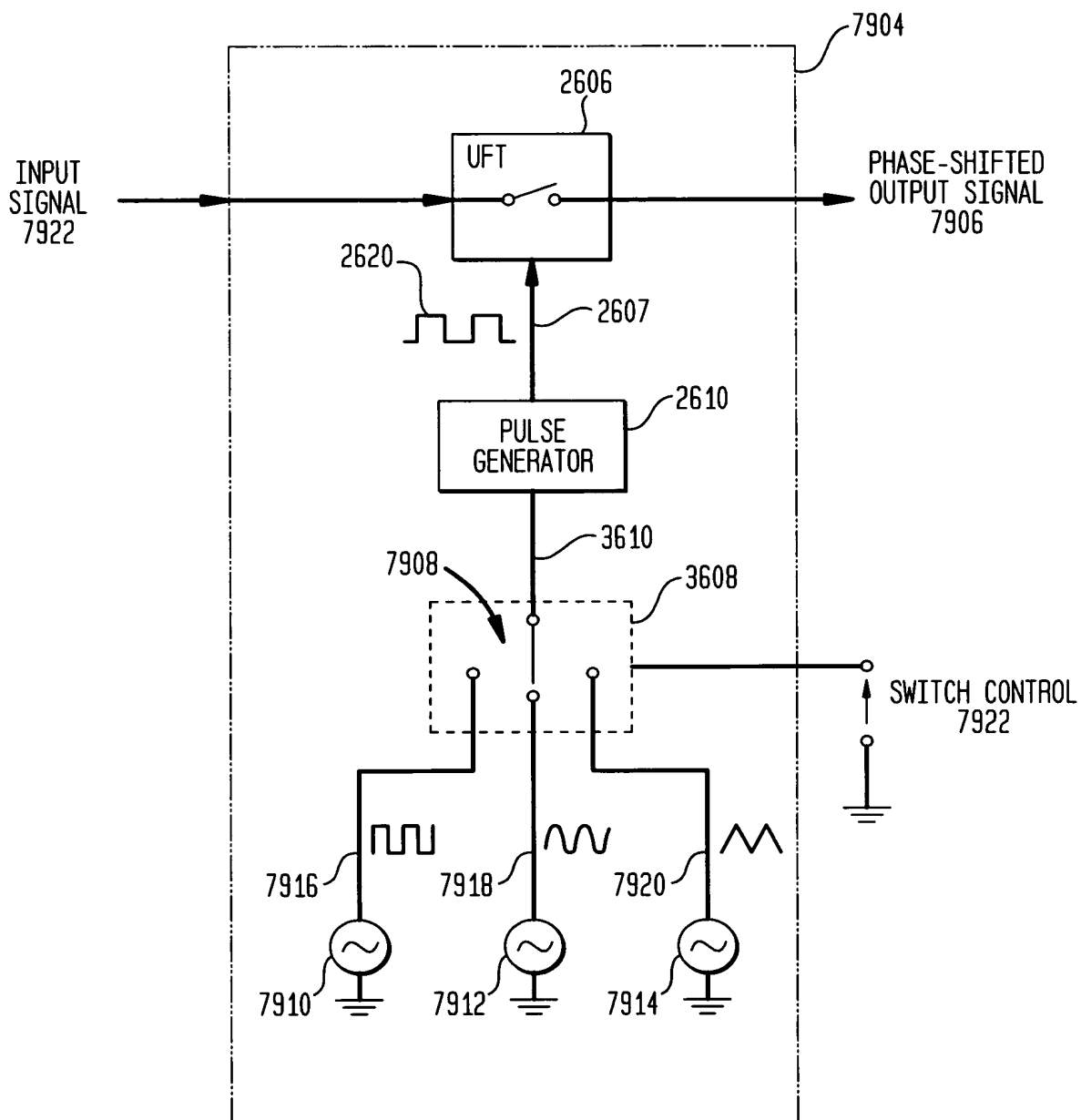


FIG. 80A

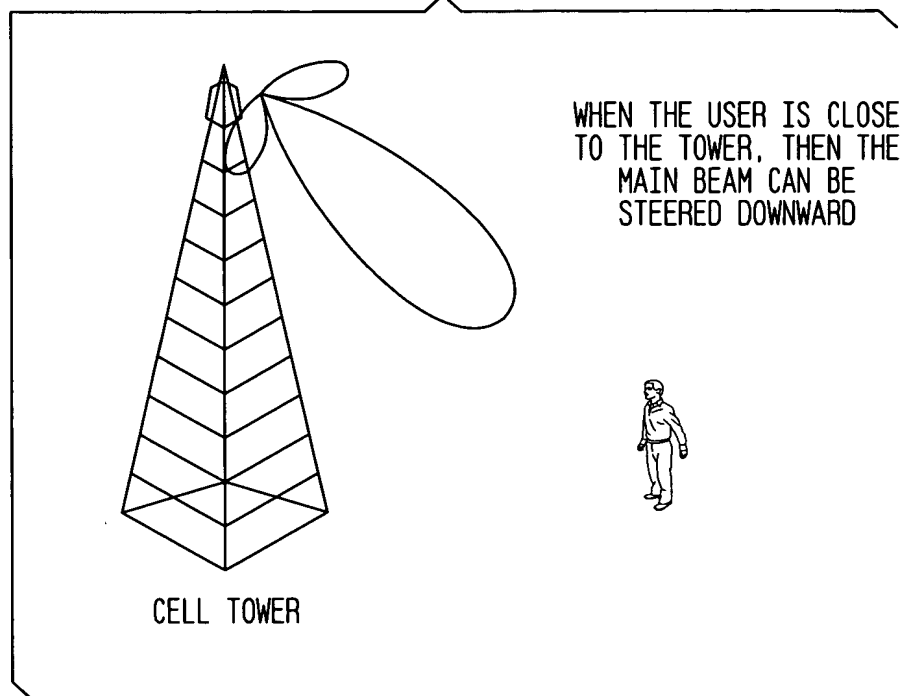


FIG. 80A

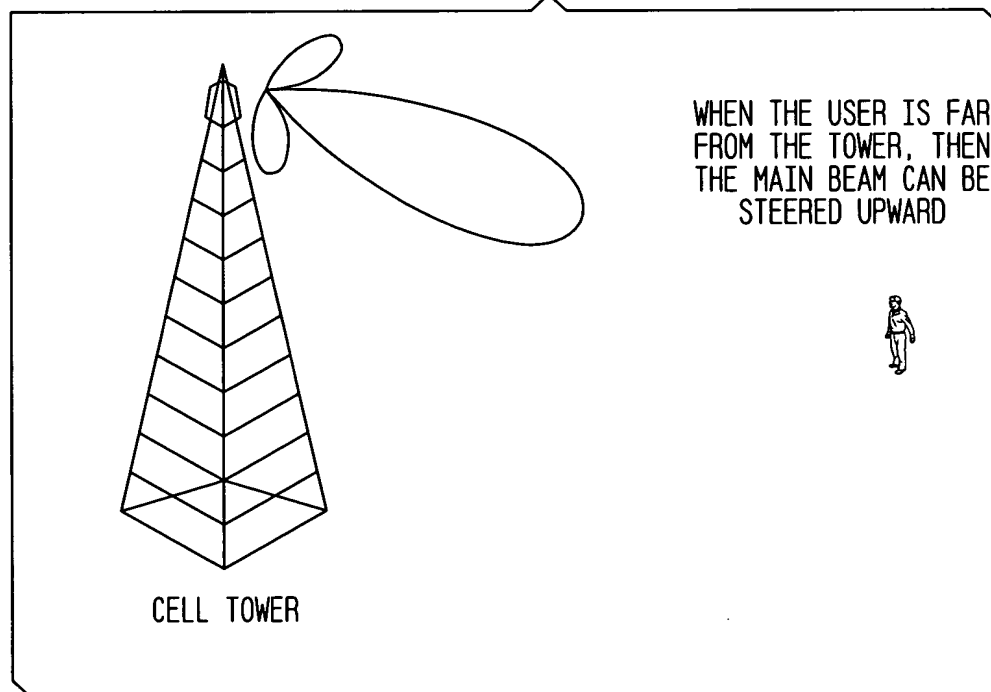


FIG. 81

Sector Loading 7:00 a.m.

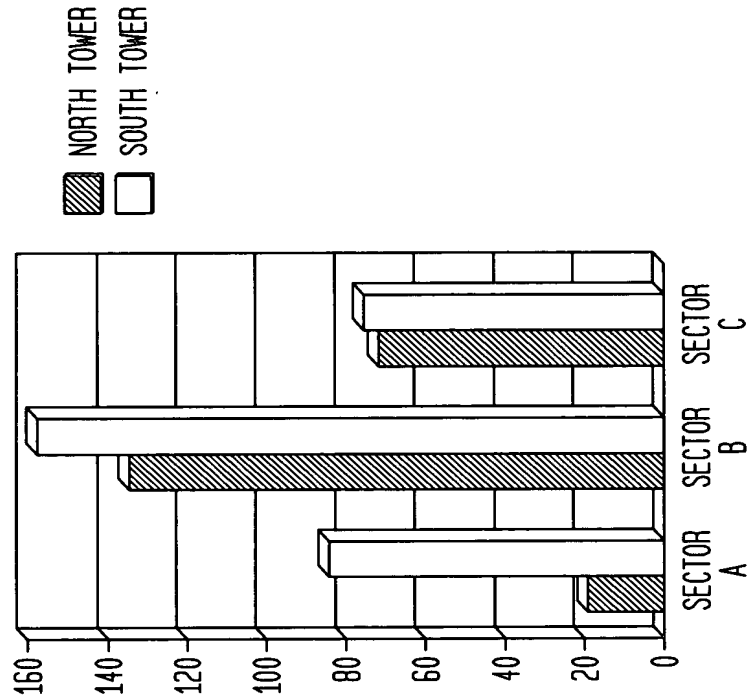
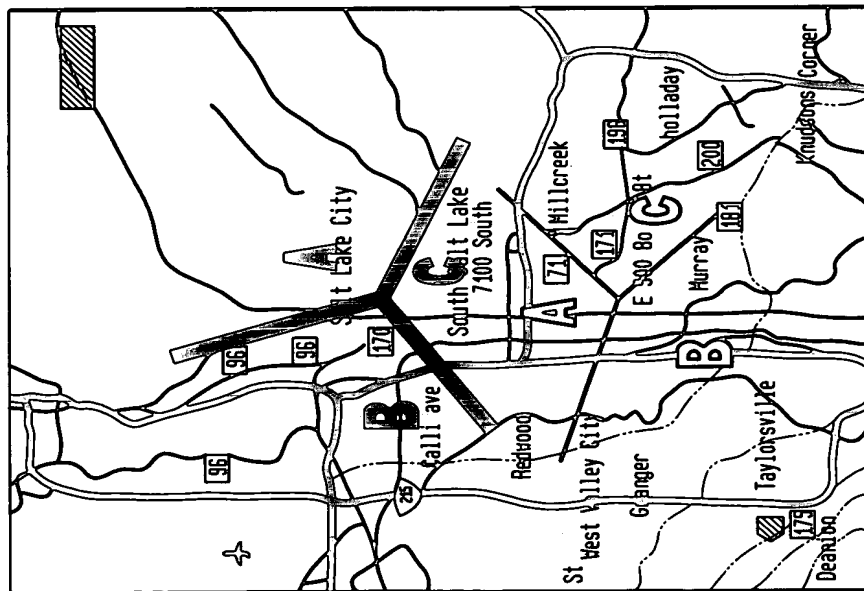


FIG. 82

Sector Loading 1:00 p.m.

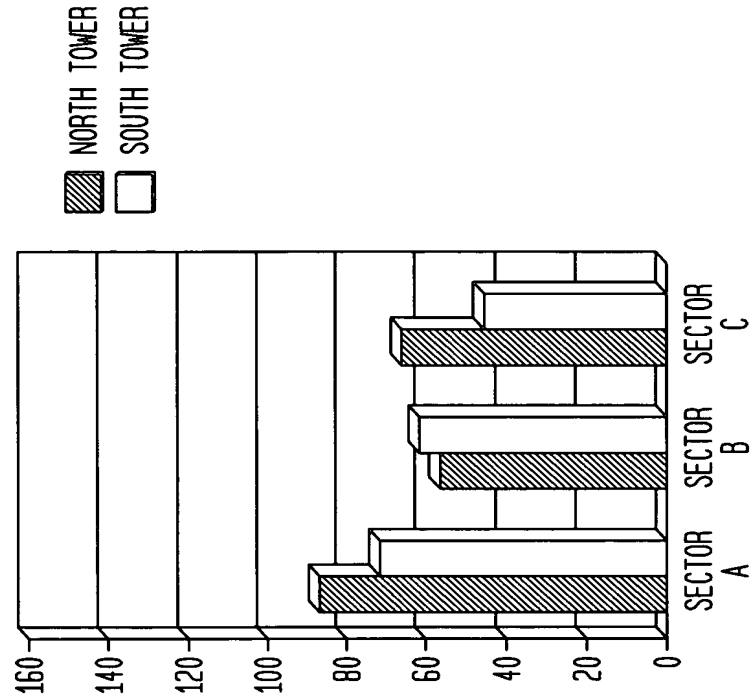
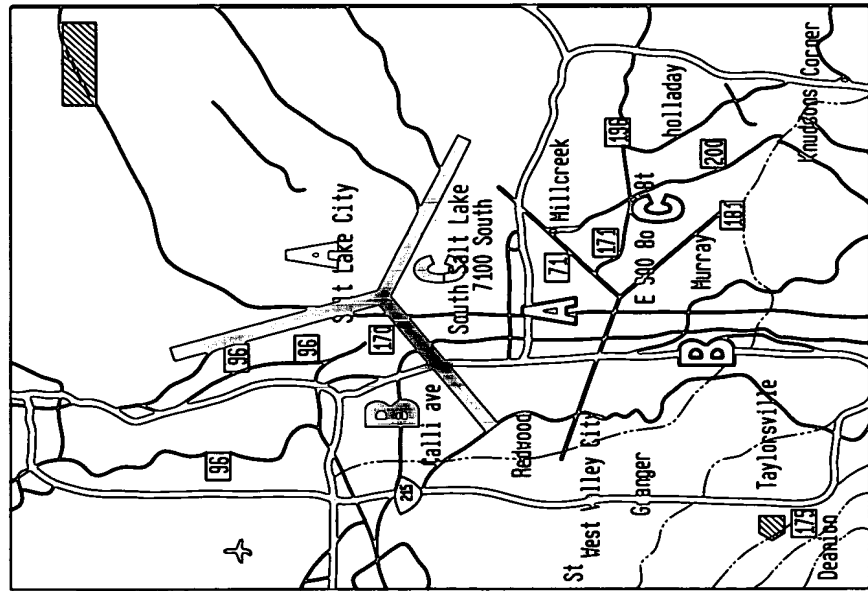


FIG. 83

Sector Loading 5:00 p.m.

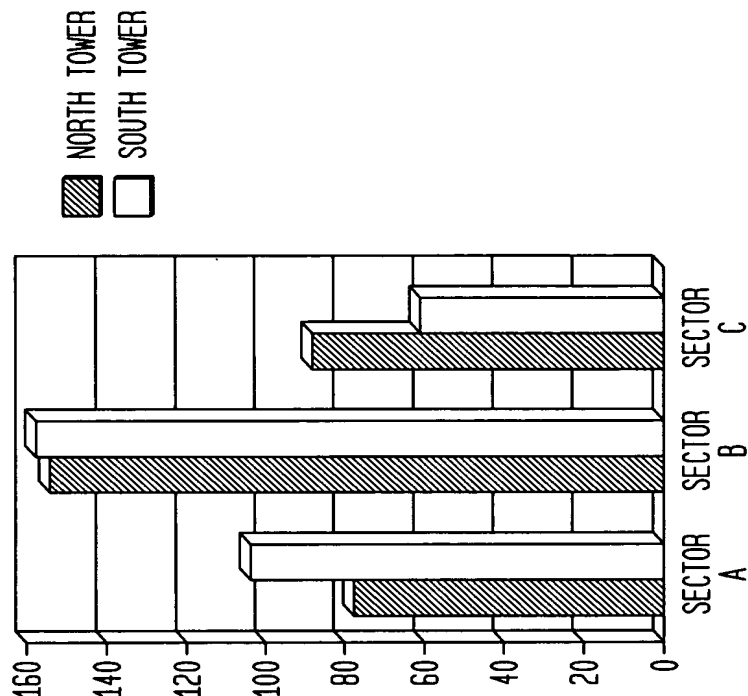
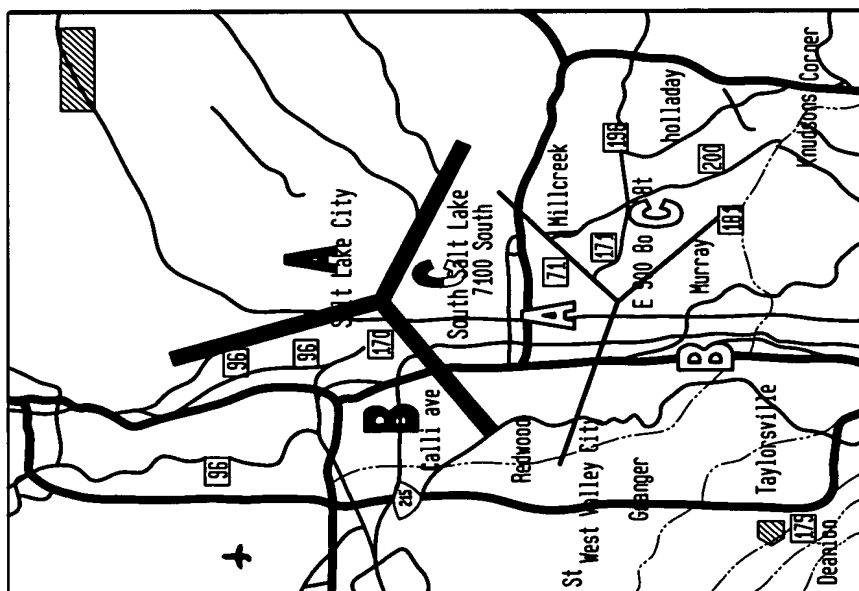


FIG. 84
 Adaptive Sector Loading 7:00 a.m.

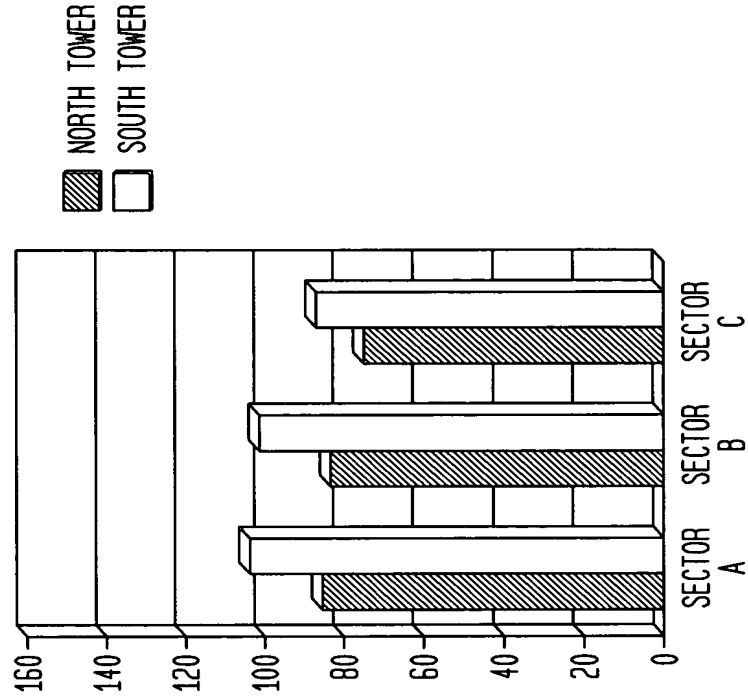
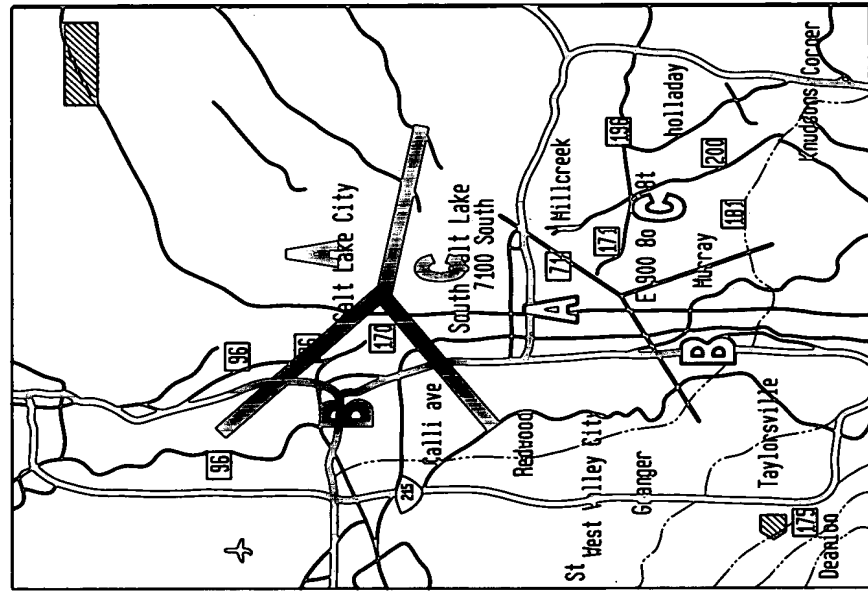


FIG. 85

Adaptive Sector Loading 1:00 p.m.

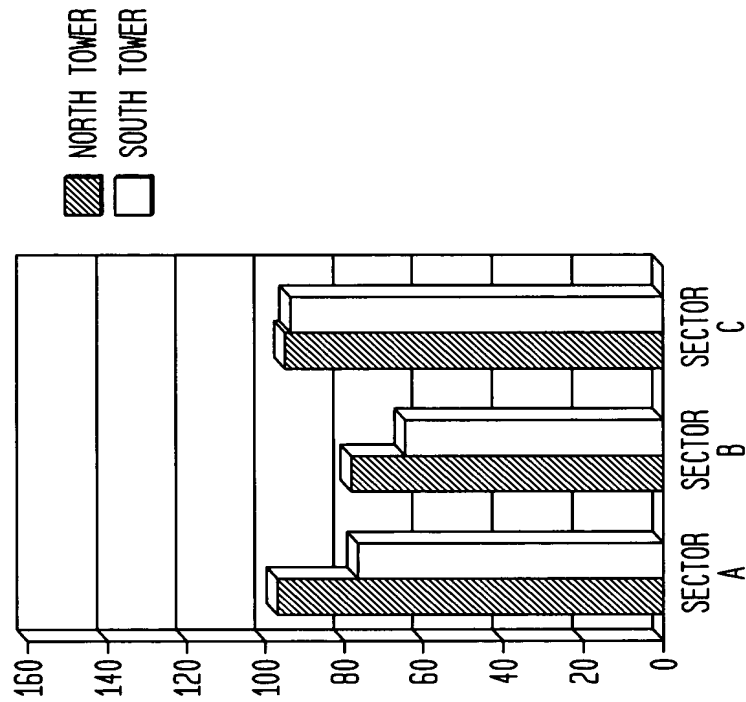
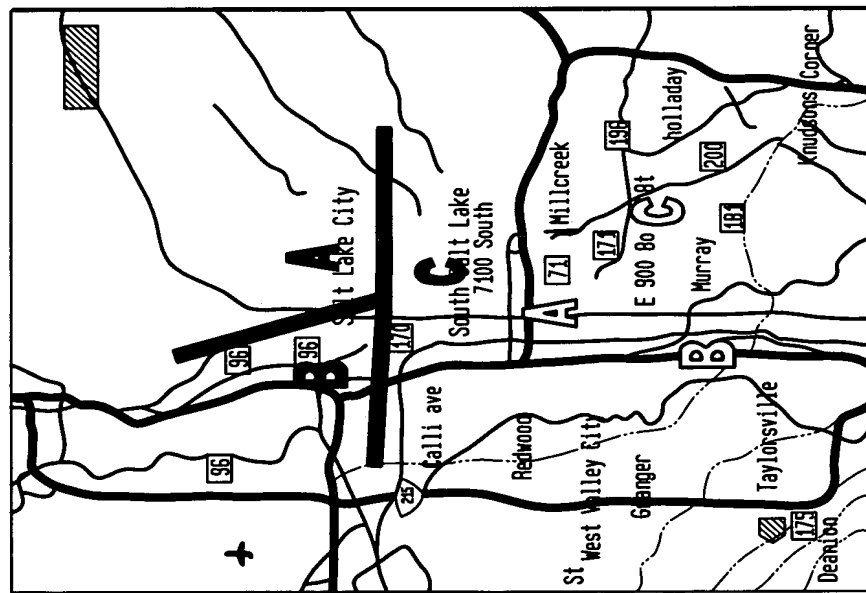


FIG. 86

Adaptive Sector Loading 5:00 p.m.

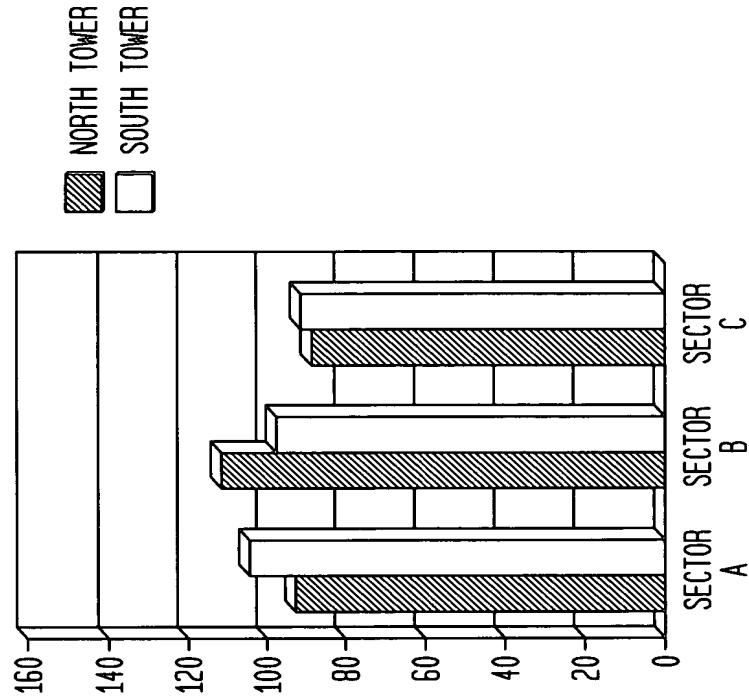
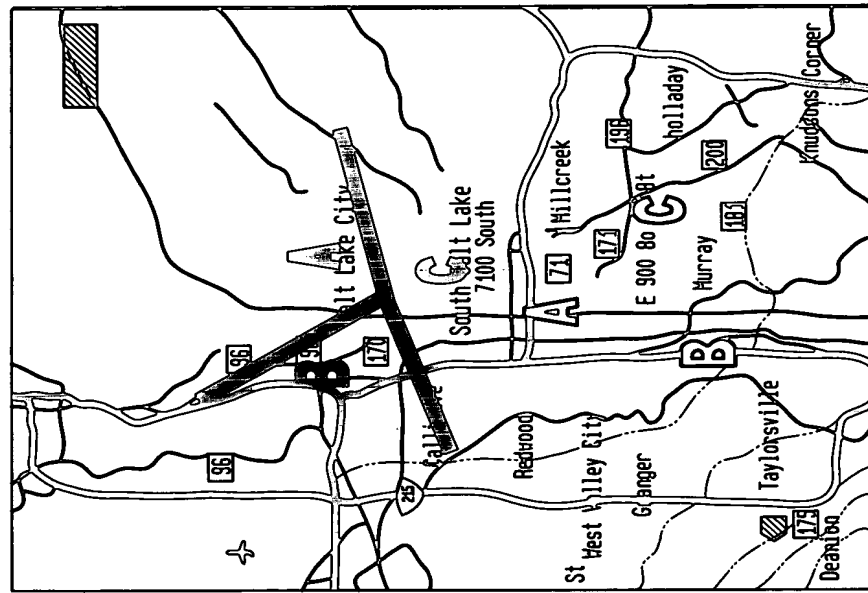


FIG. 87A

WIDE SECTOR

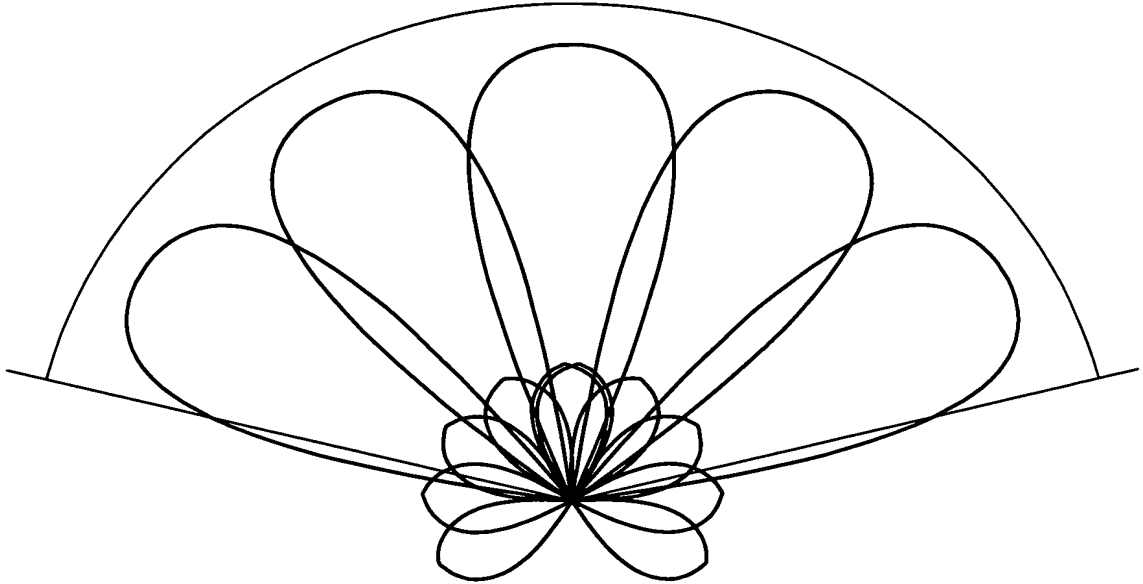


FIG. 87B

NARROW SECTOR

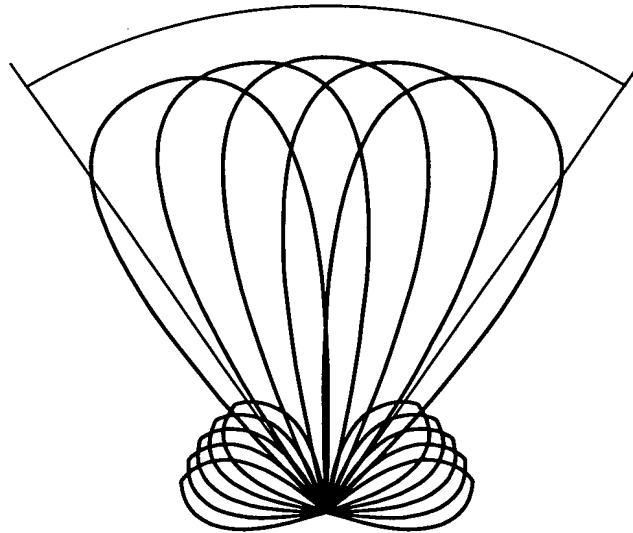


FIG. 88

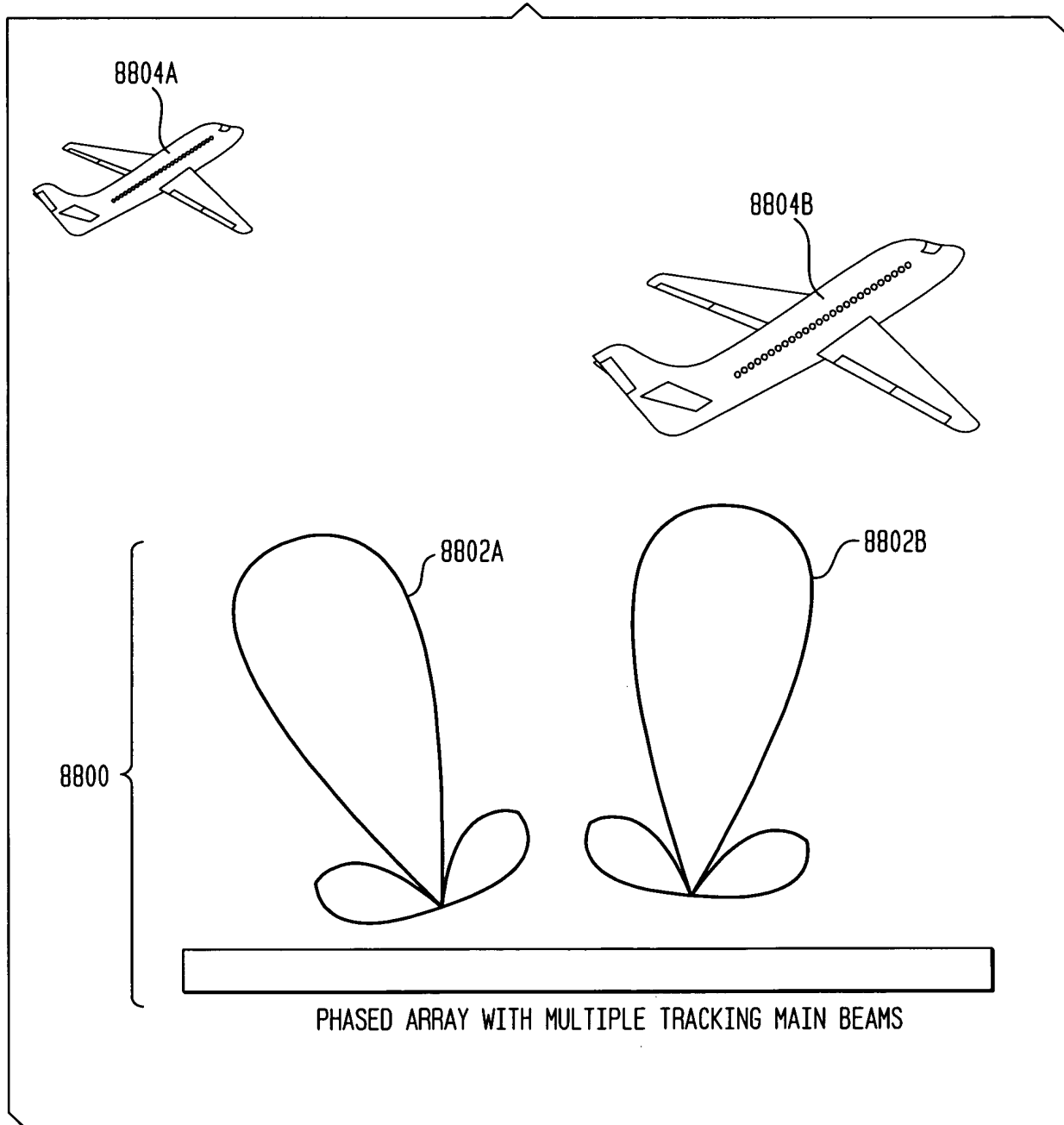
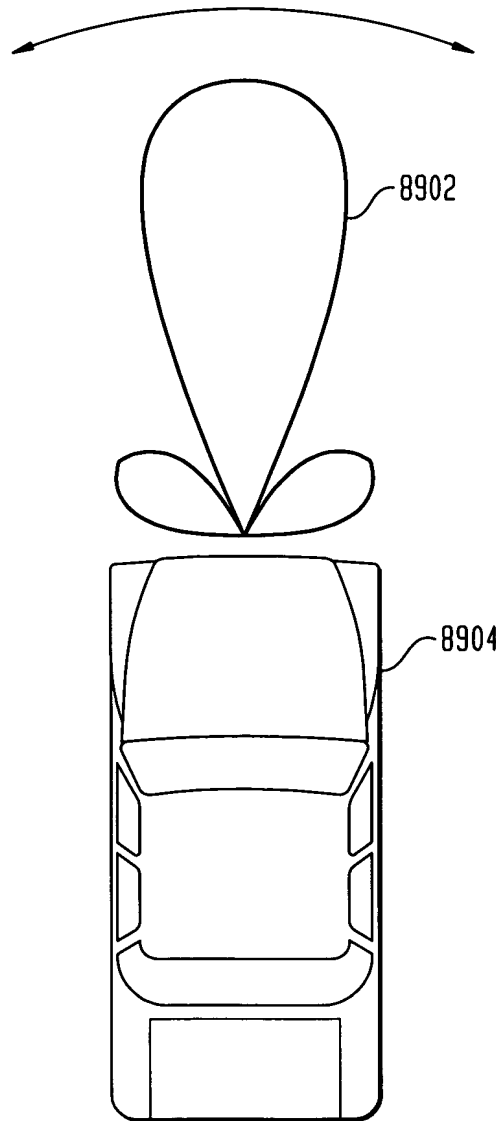


FIG. 89

SCANNING FOR OBSTACLES



8900

8902

8904

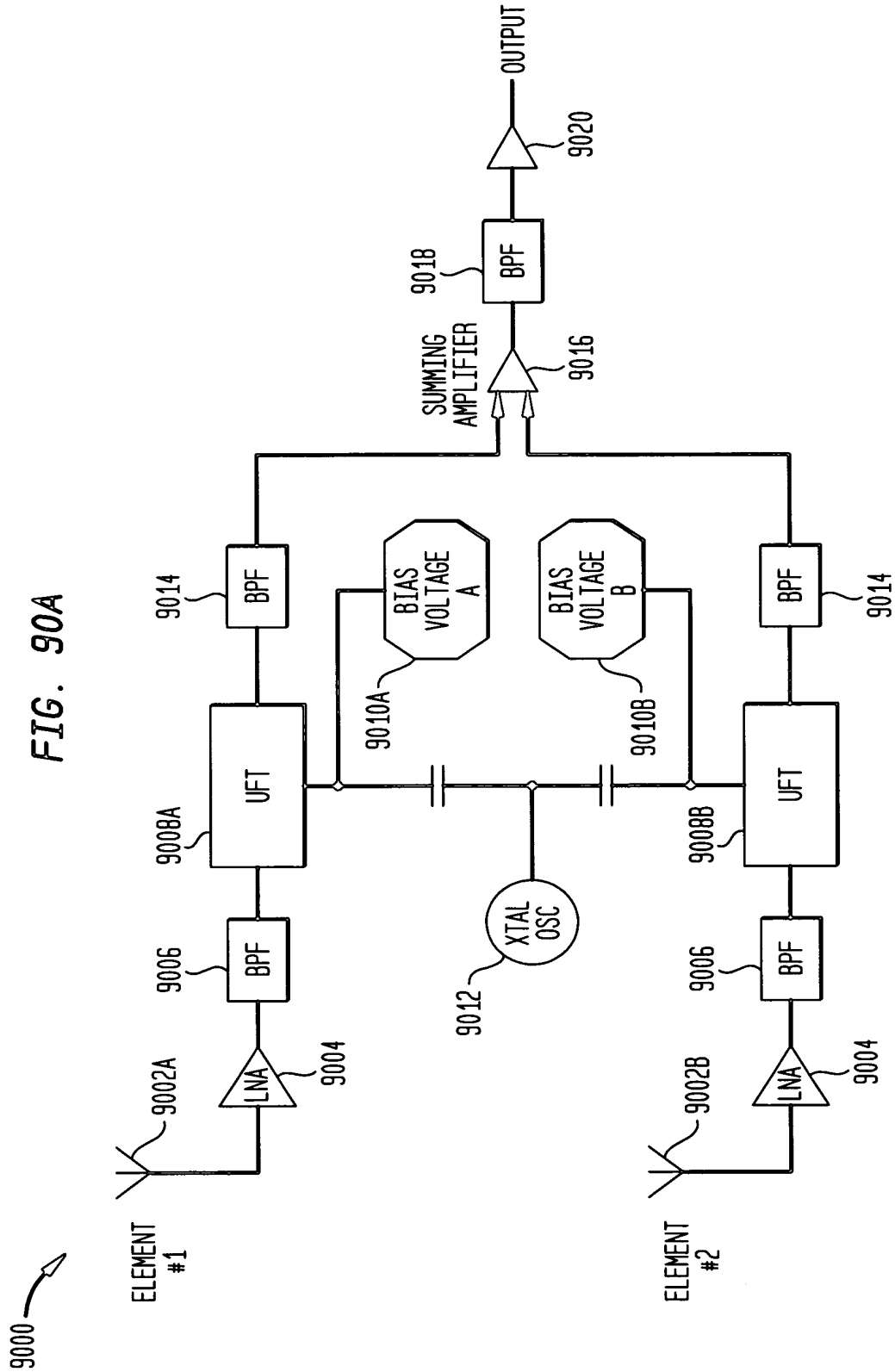


FIG. 90B

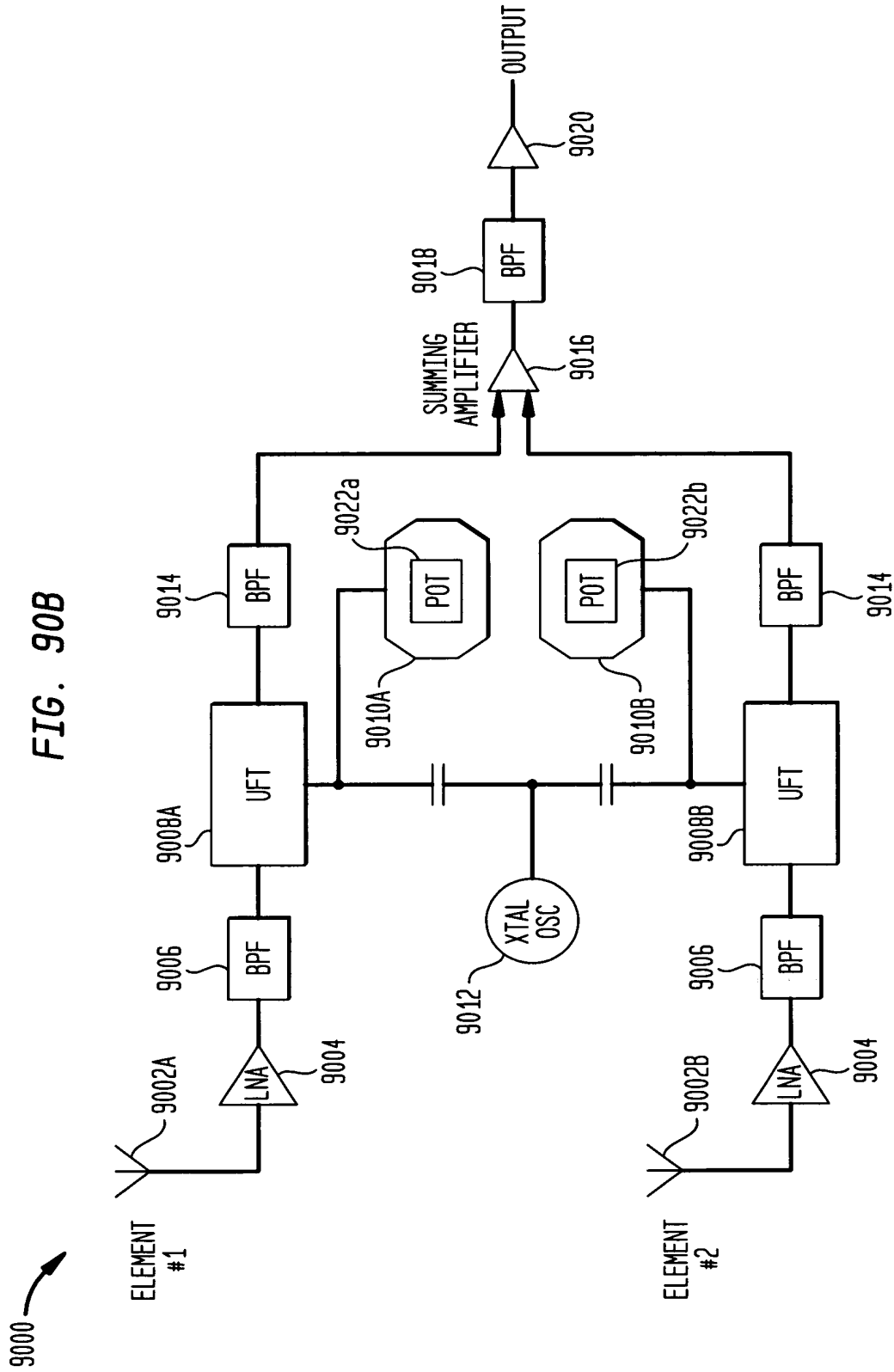


FIG. 91A
 0 DEGREE SCAN ANGLE

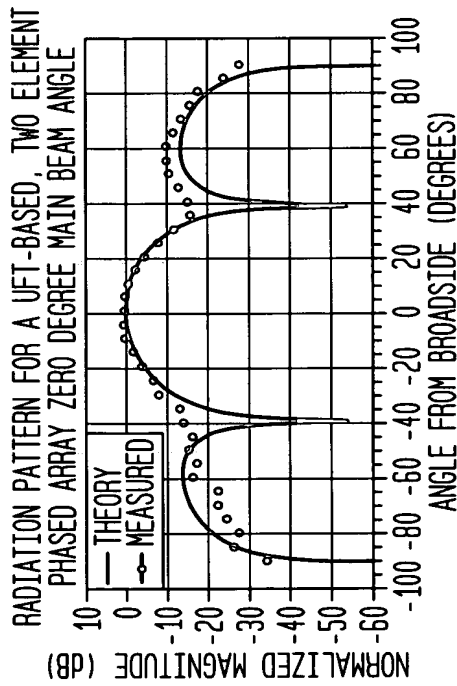


FIG. 91B
 -15 DEGREE SCAN ANGLE

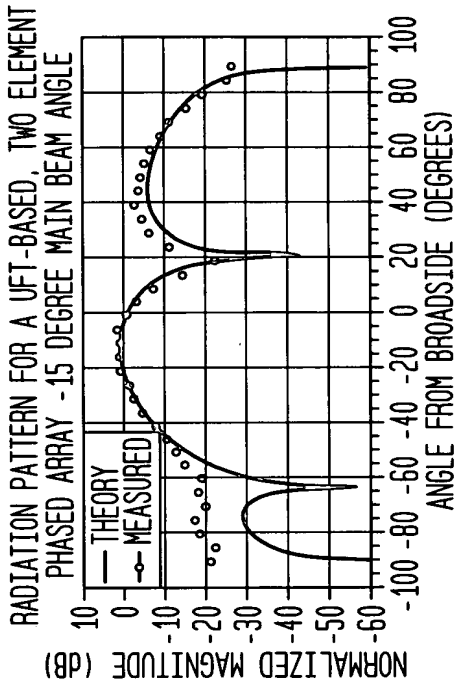


FIG. 91C
 40 DEGREE SCAN ANGLE

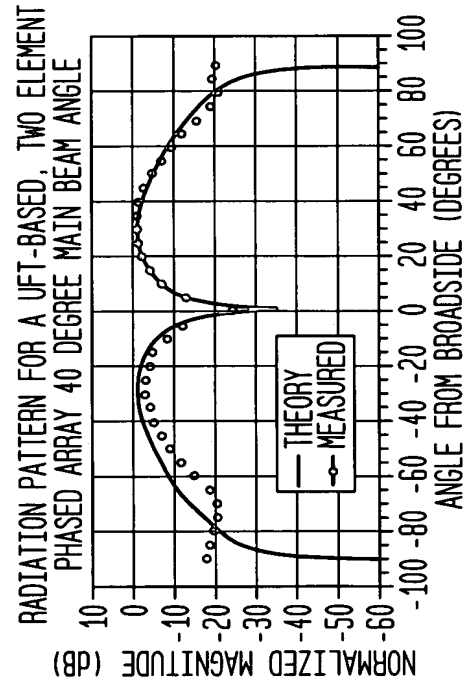


FIG. 91D
 15 DEGREE SCAN ANGLE

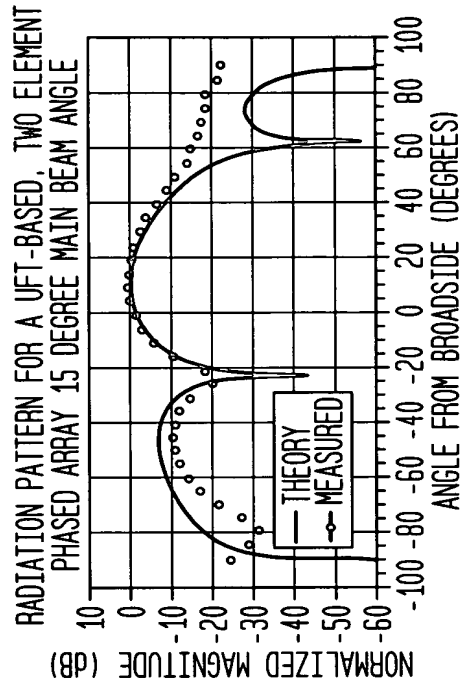


FIG. 92A

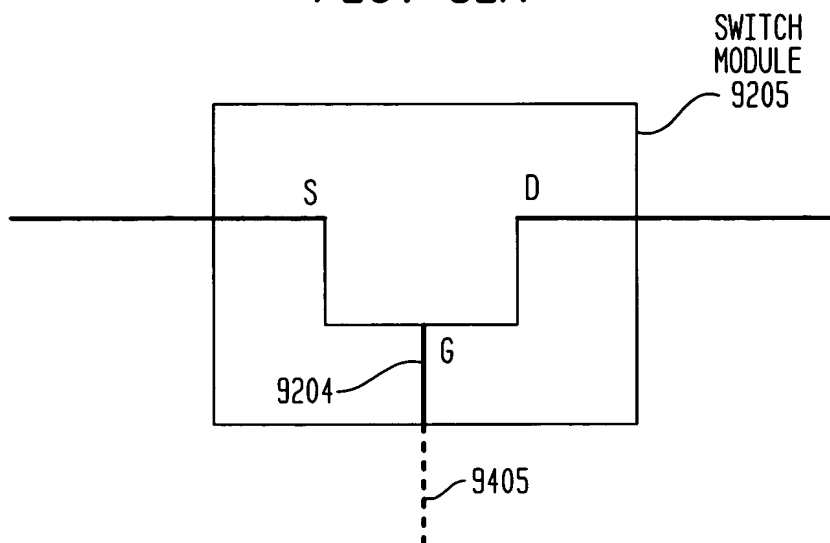


FIG. 92B

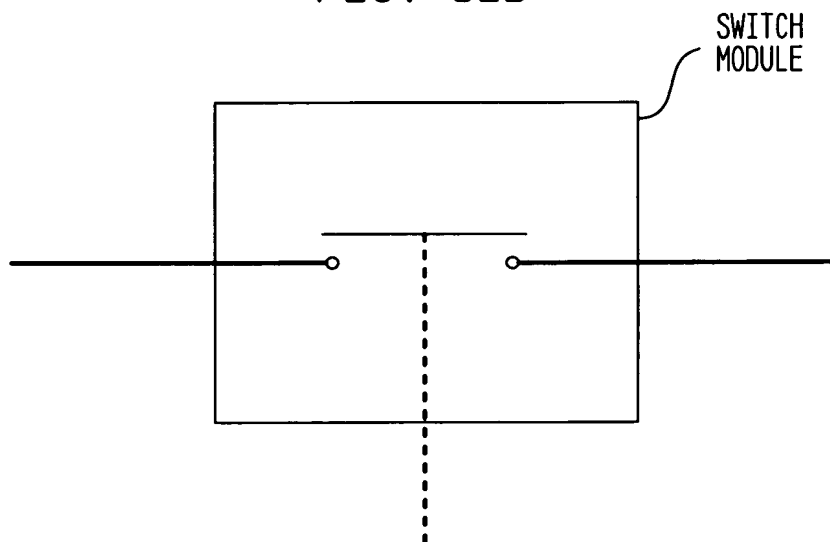


FIG. 92C

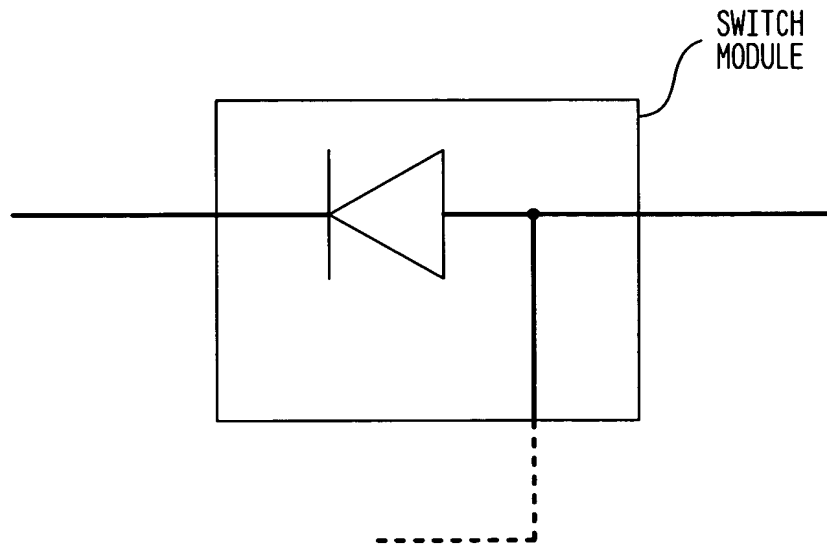


FIG. 92D

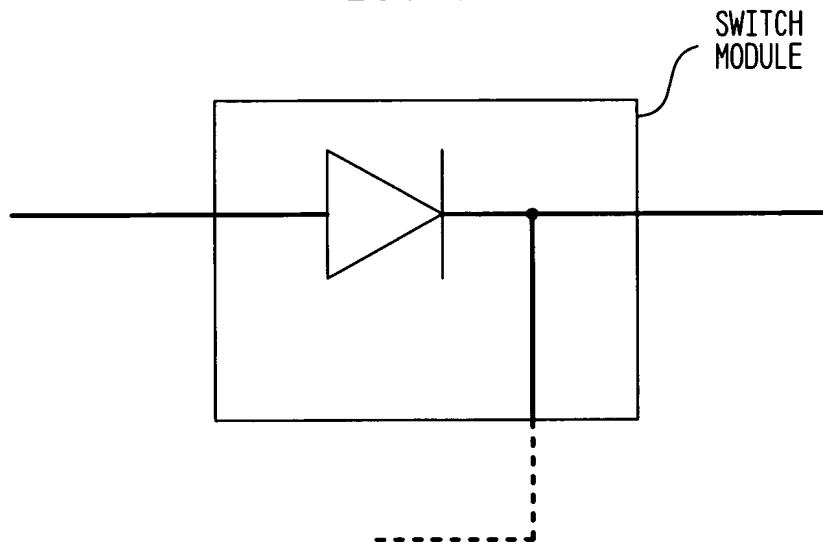


FIG. 93A

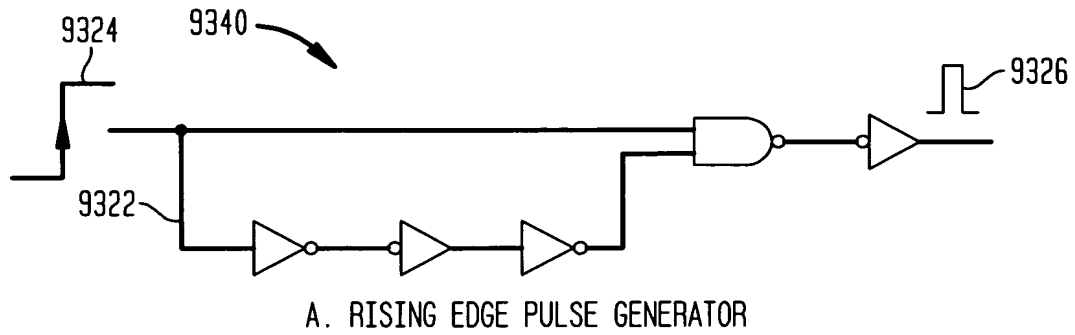


FIG. 93B

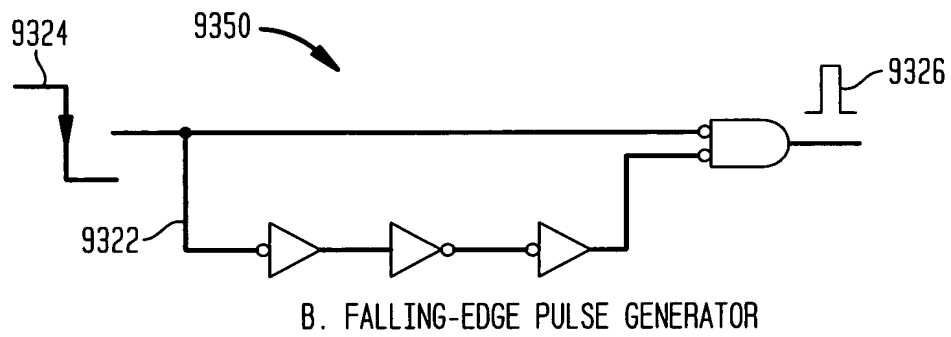
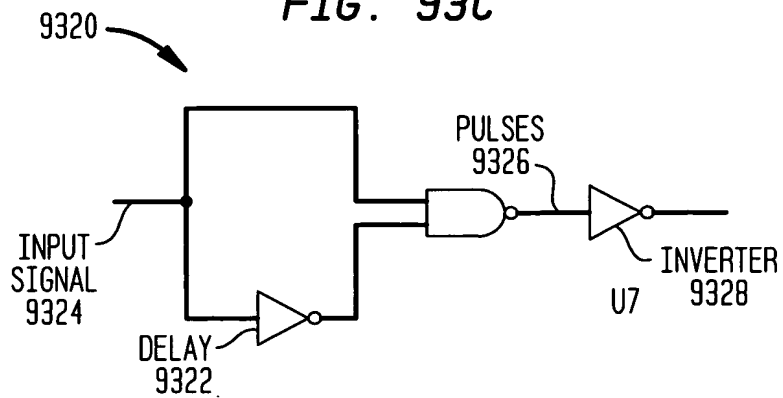


FIG. 93C



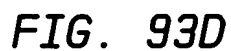


FIG. 94

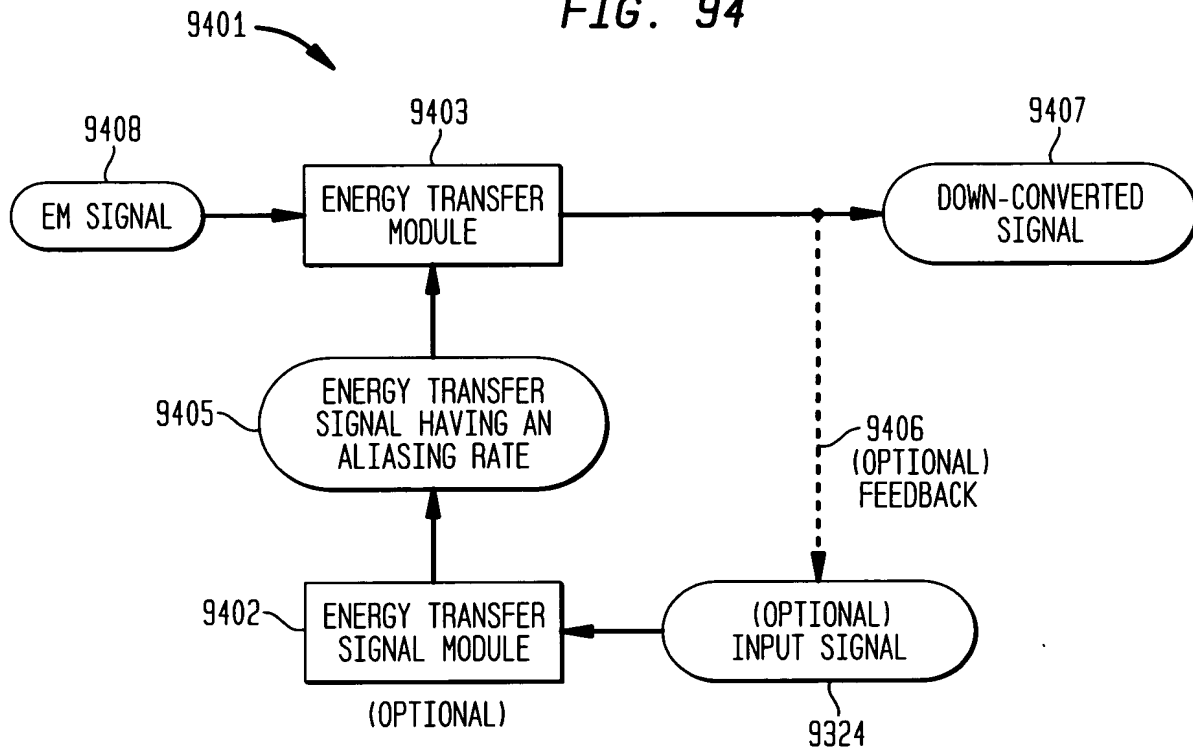


FIG. 95

IMPEDANCE MATCHED ALIASING MODULE

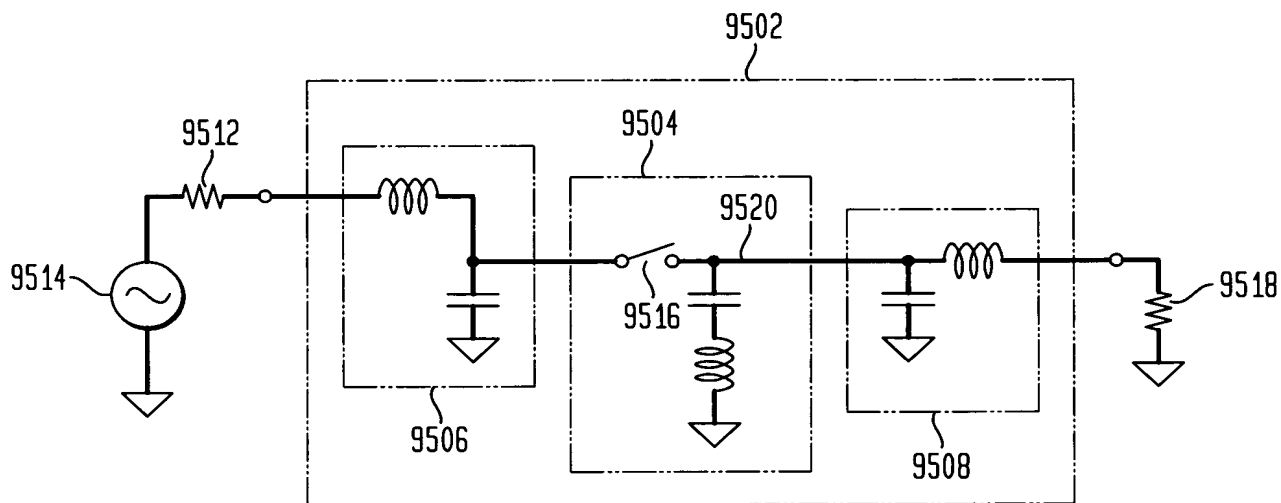


FIG. 96A

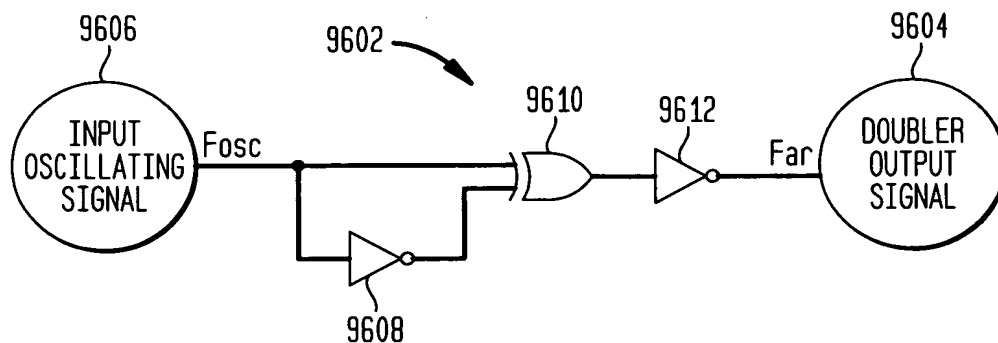


FIG. 96B

9606

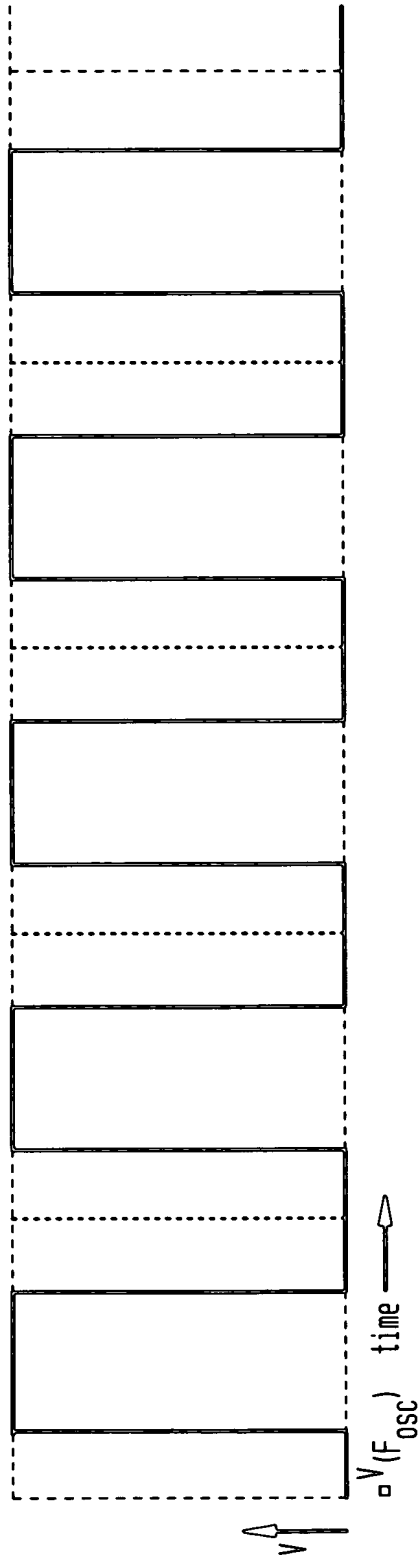


FIG. 96C

9604

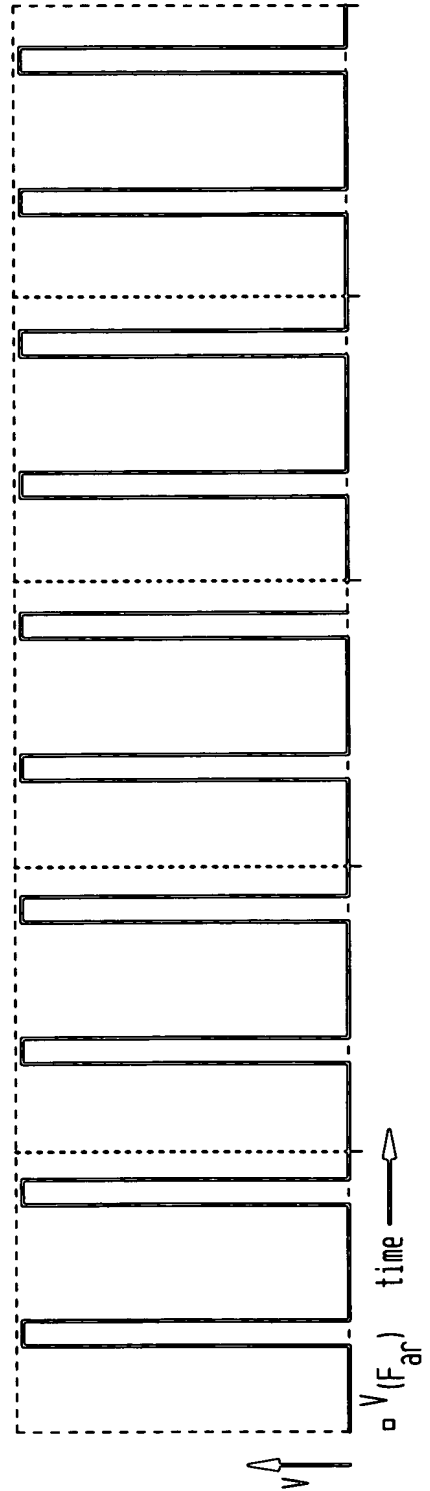


FIG. 97

ALIASING MODULE

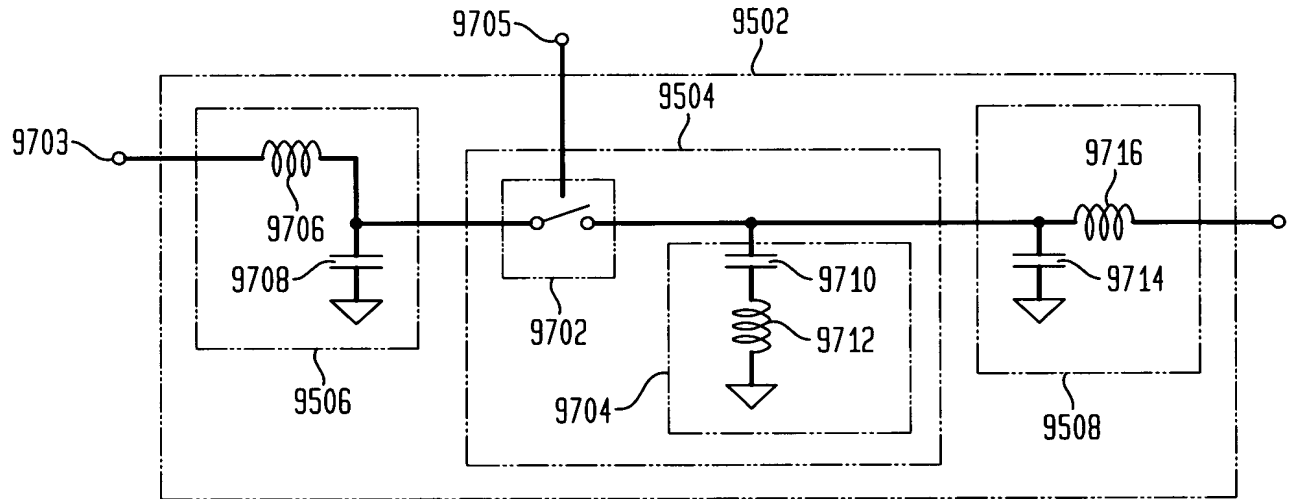


FIG. 98A

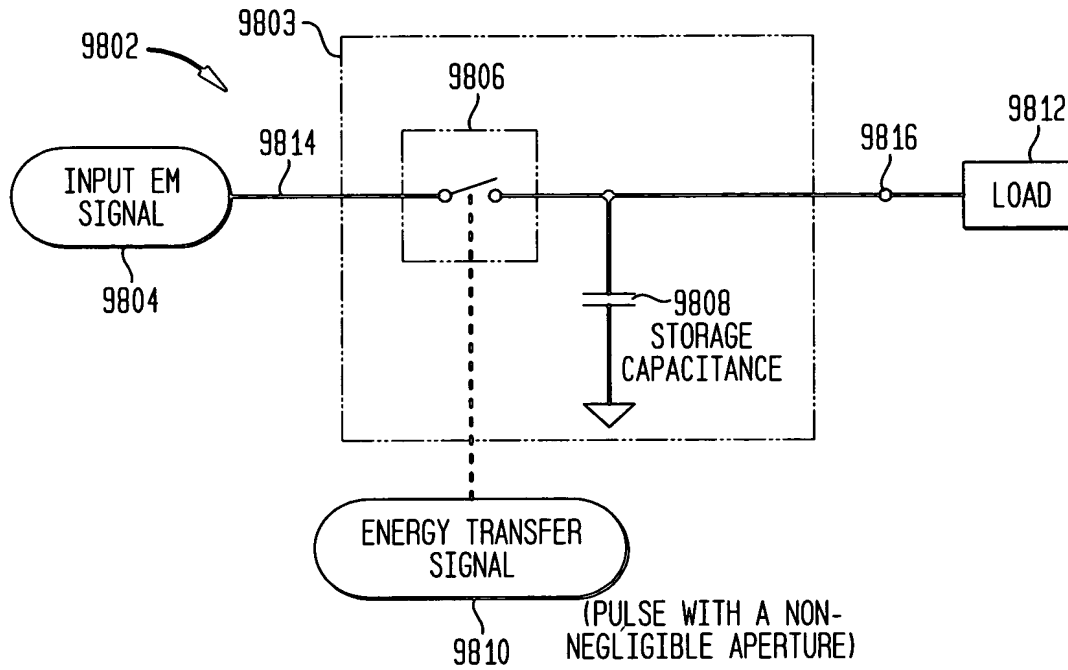


FIG. 98B

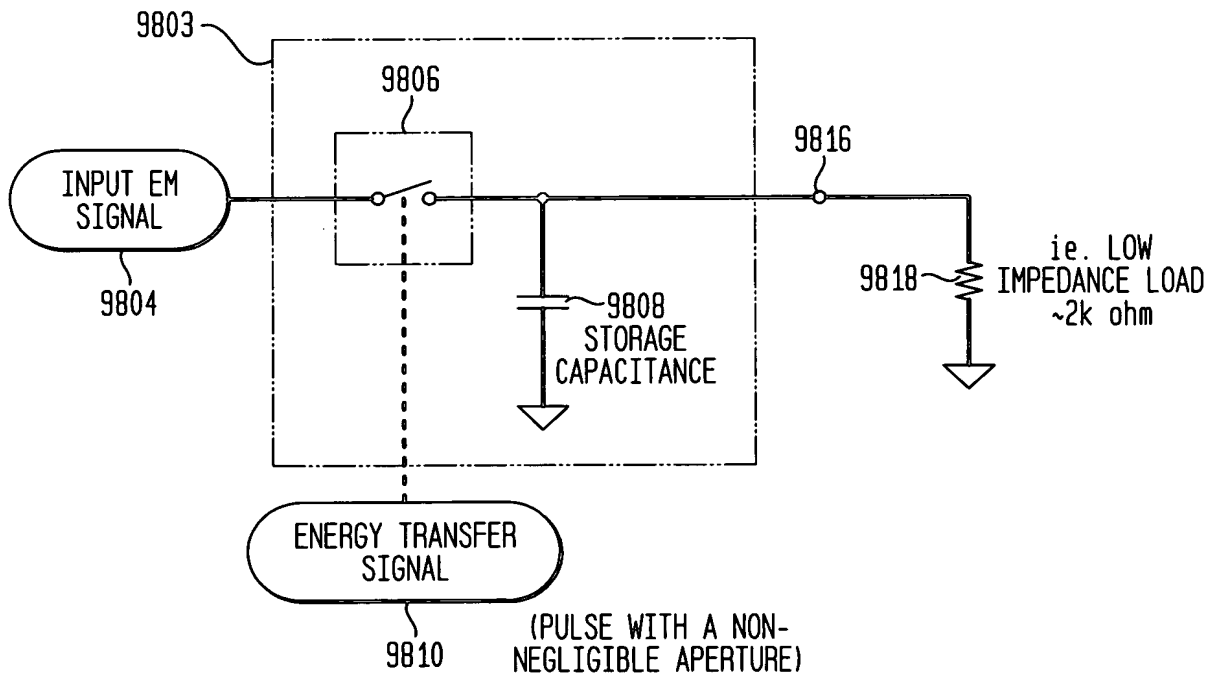


FIG. 99A

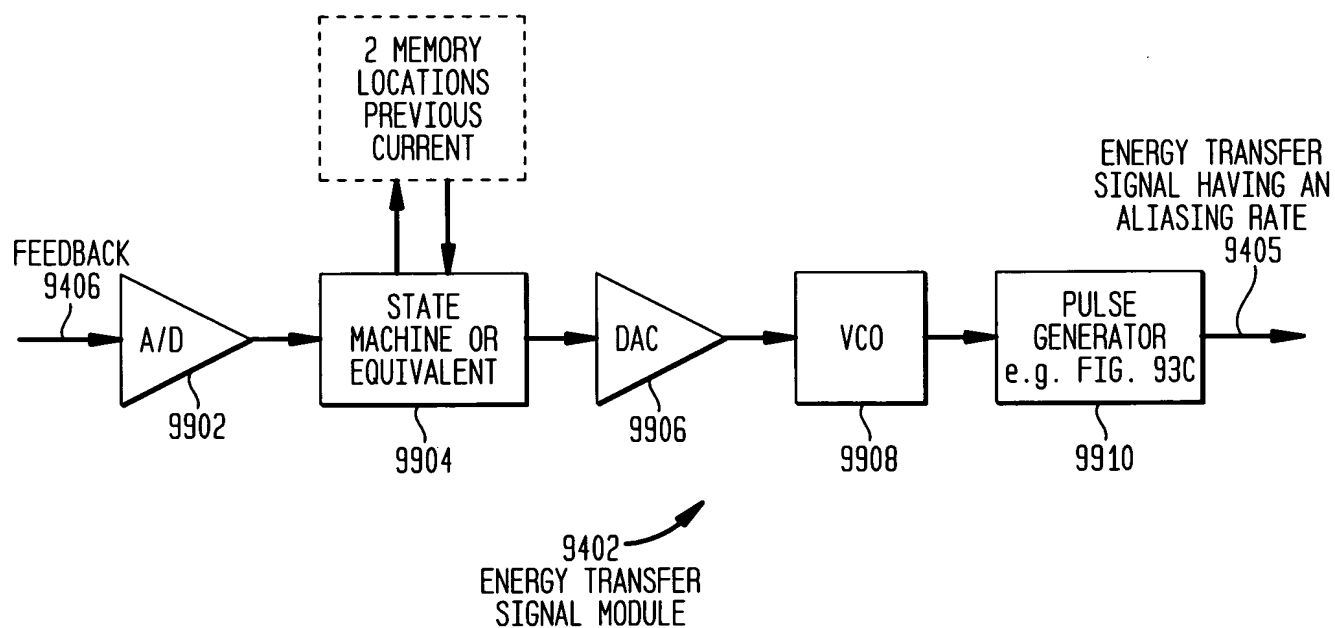
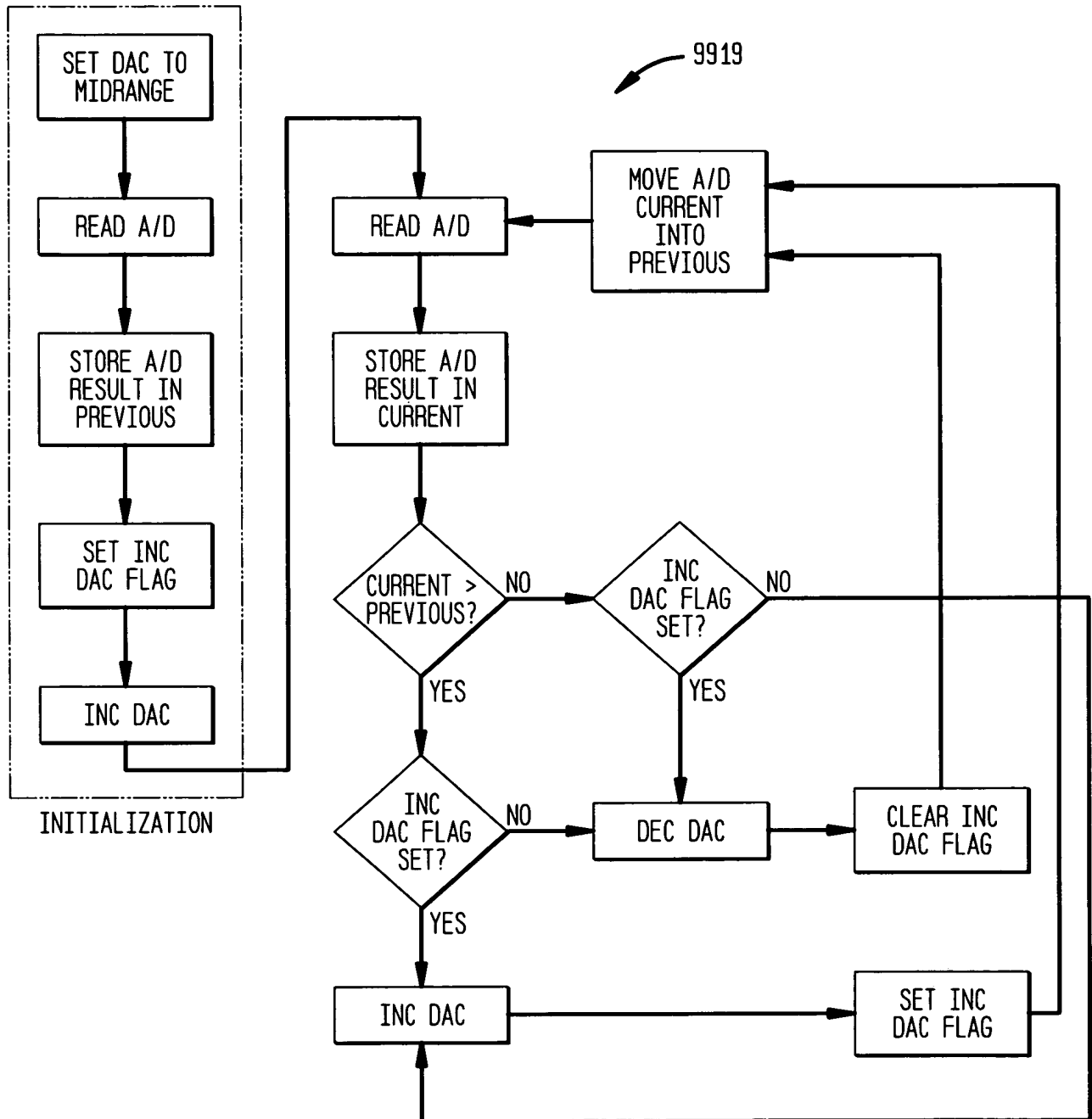


FIG. 99B



STATE MACHINE FLOWCHART

FIG. 99C

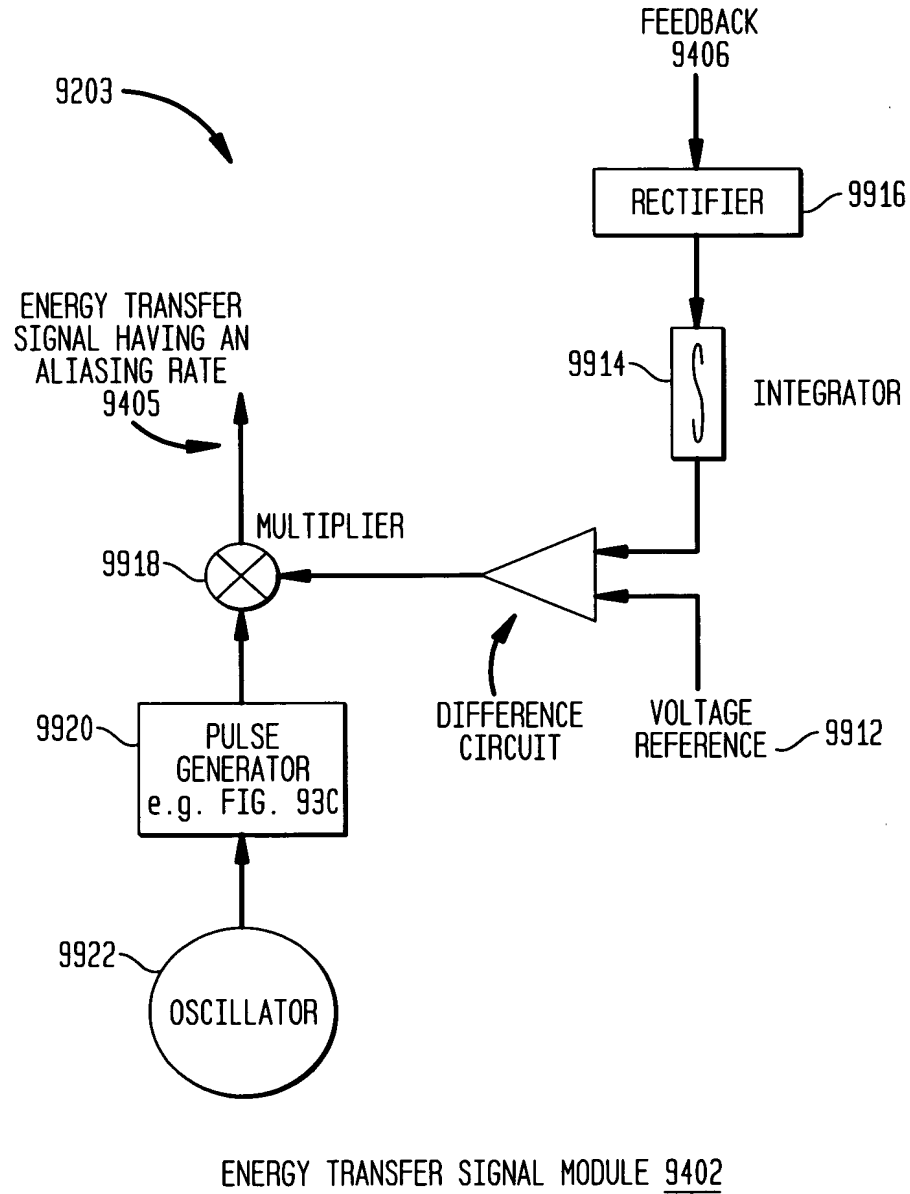


FIG. 100

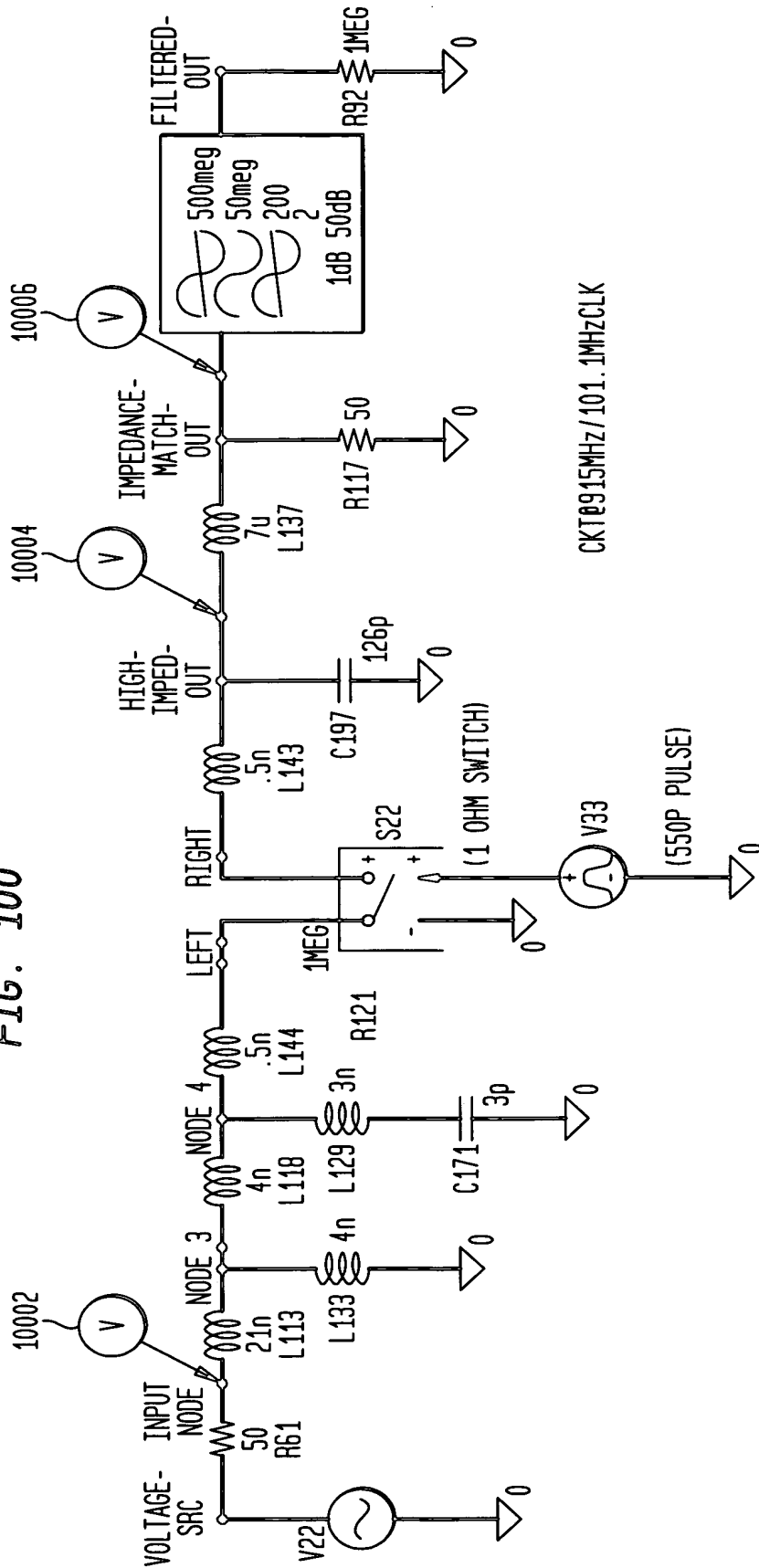


FIG. 101

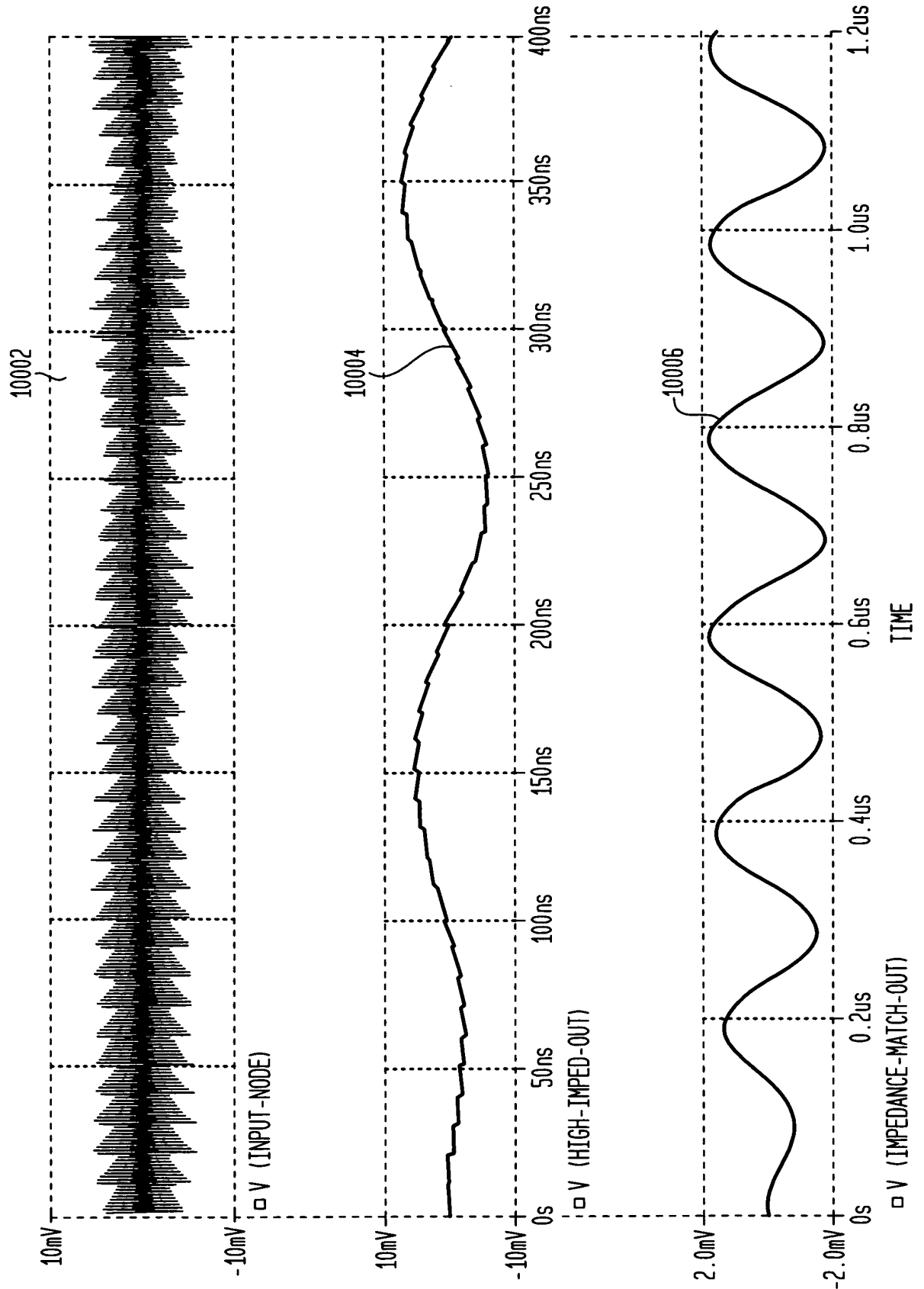


FIG. 102

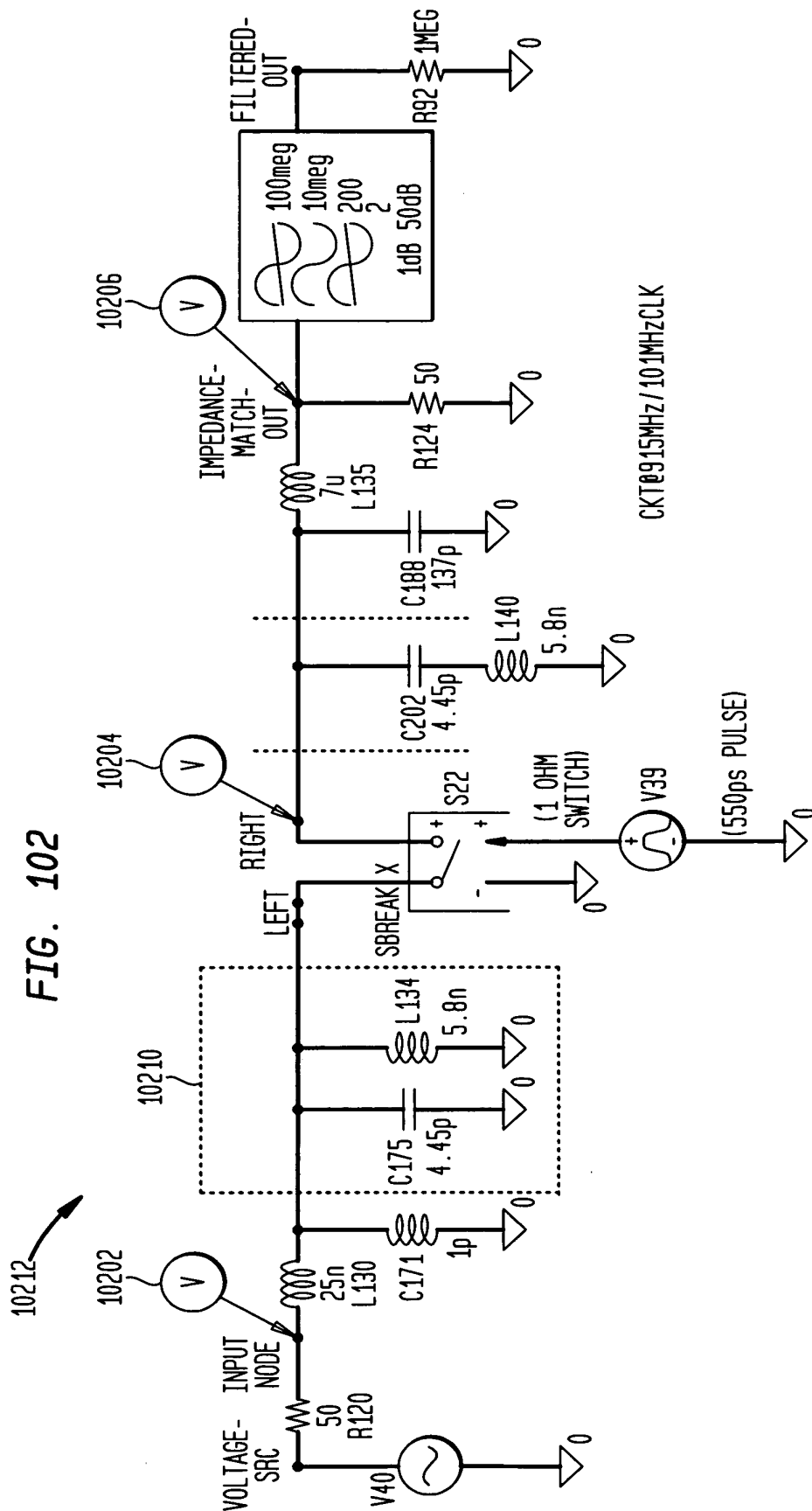


FIG. 103

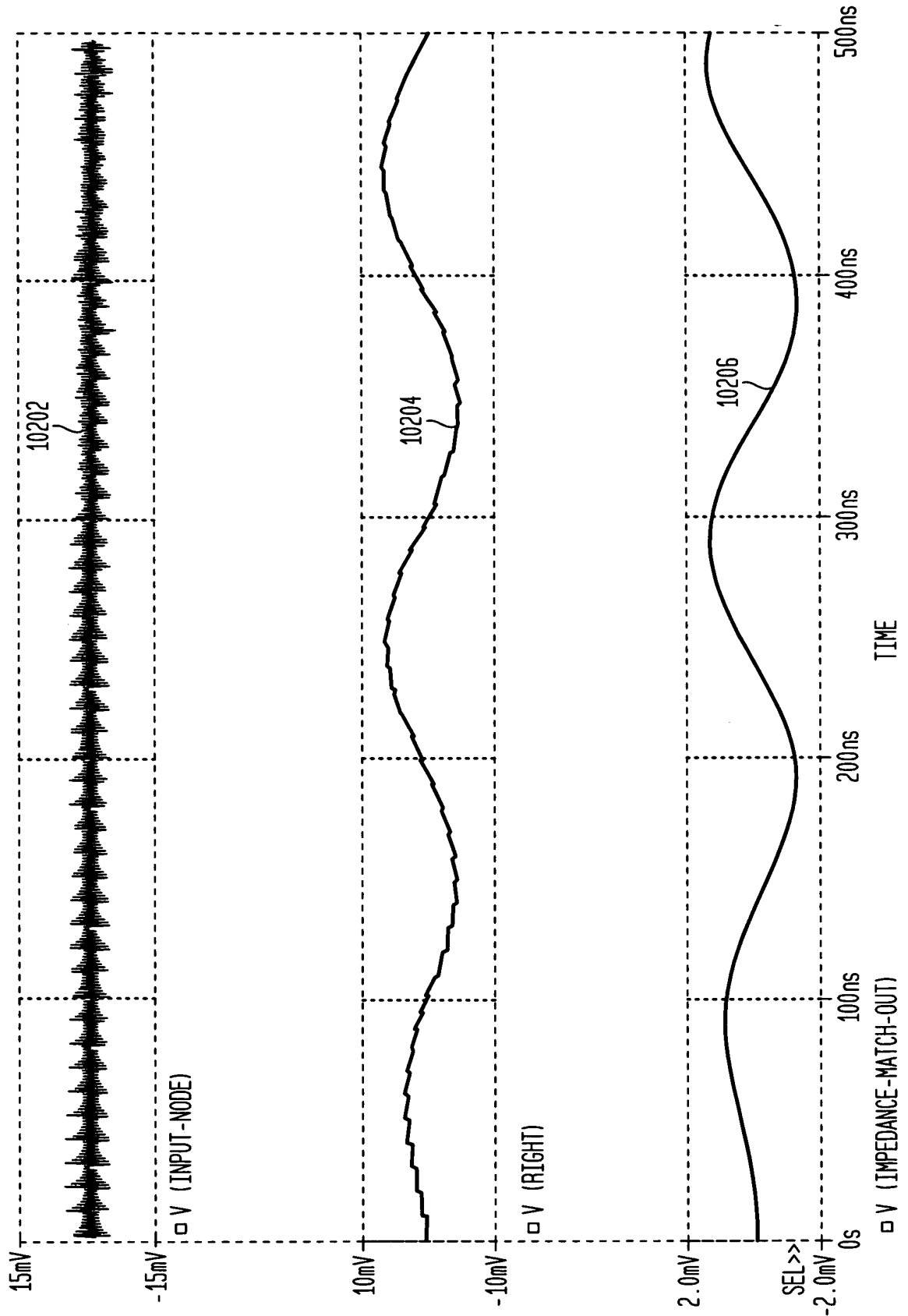


FIG. 104

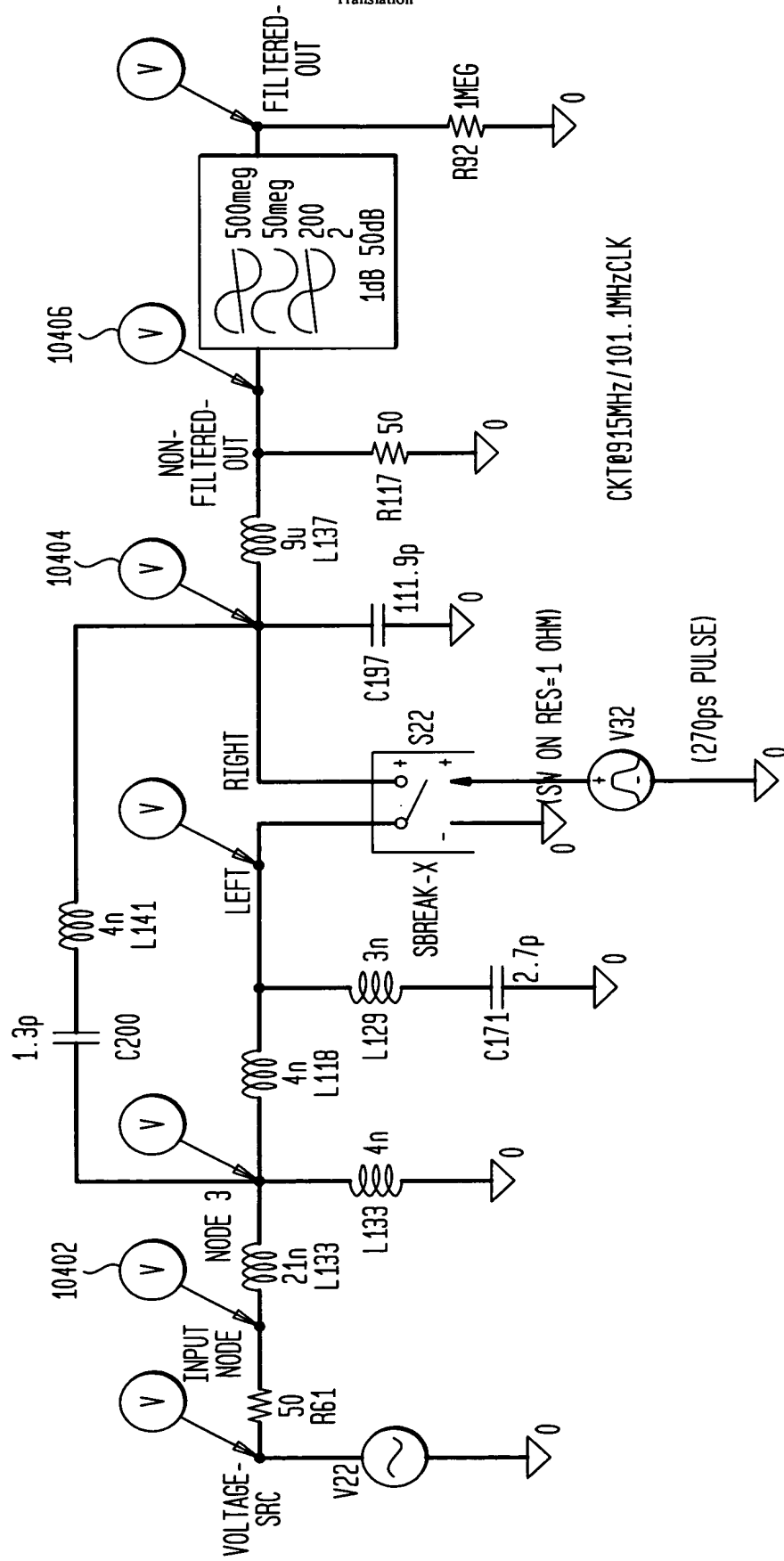


FIG. 105

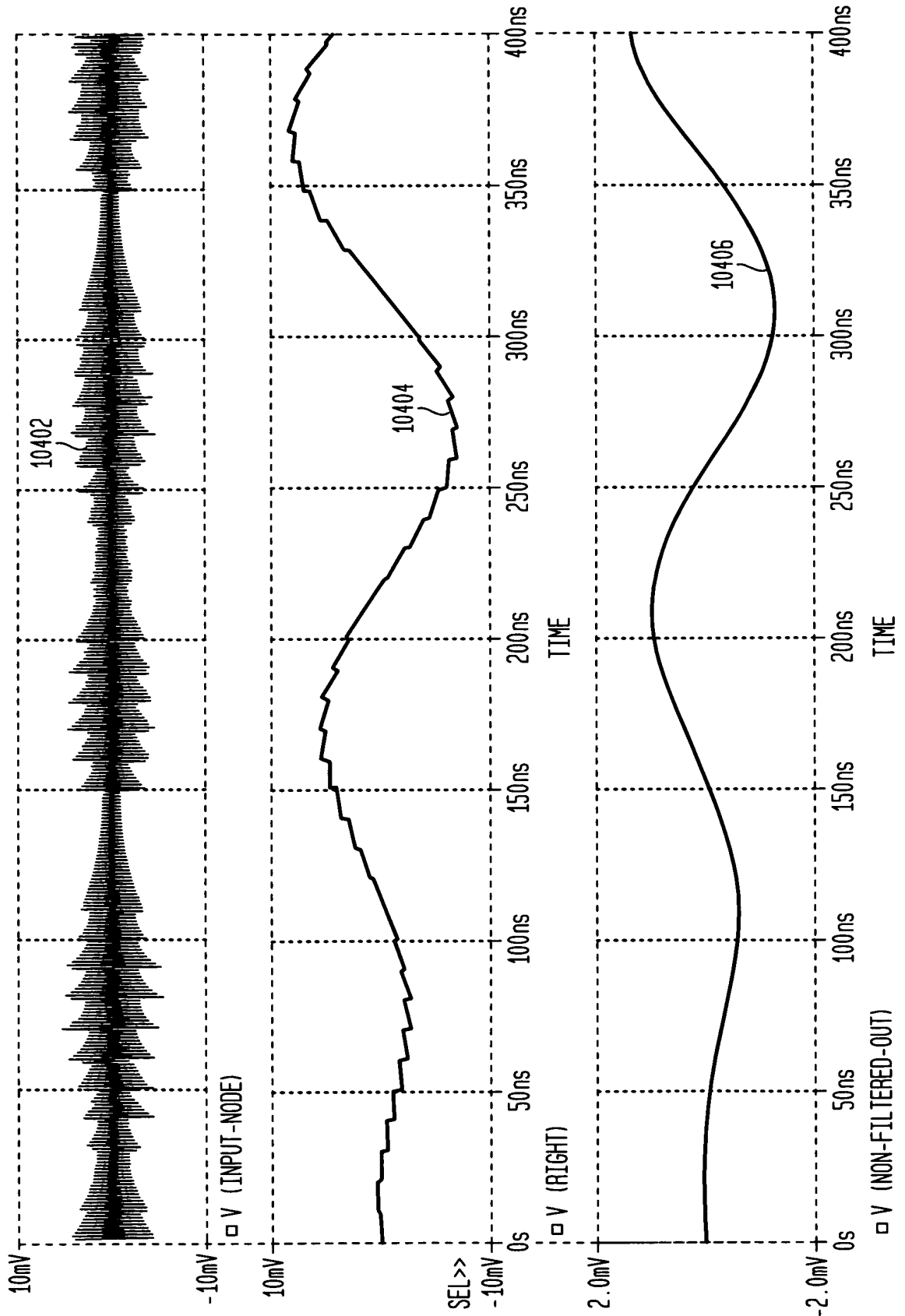


FIG. 106

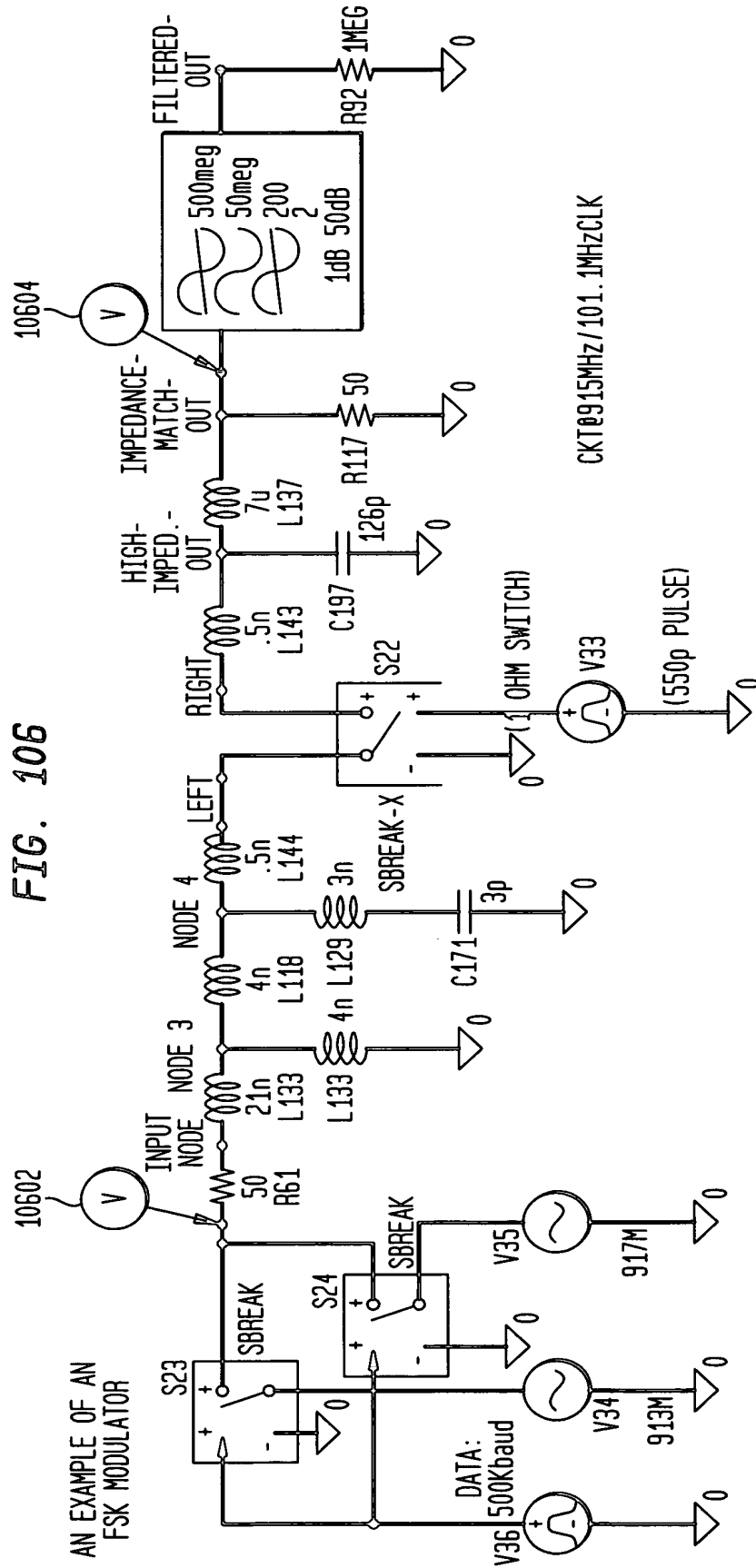


FIG. 107A

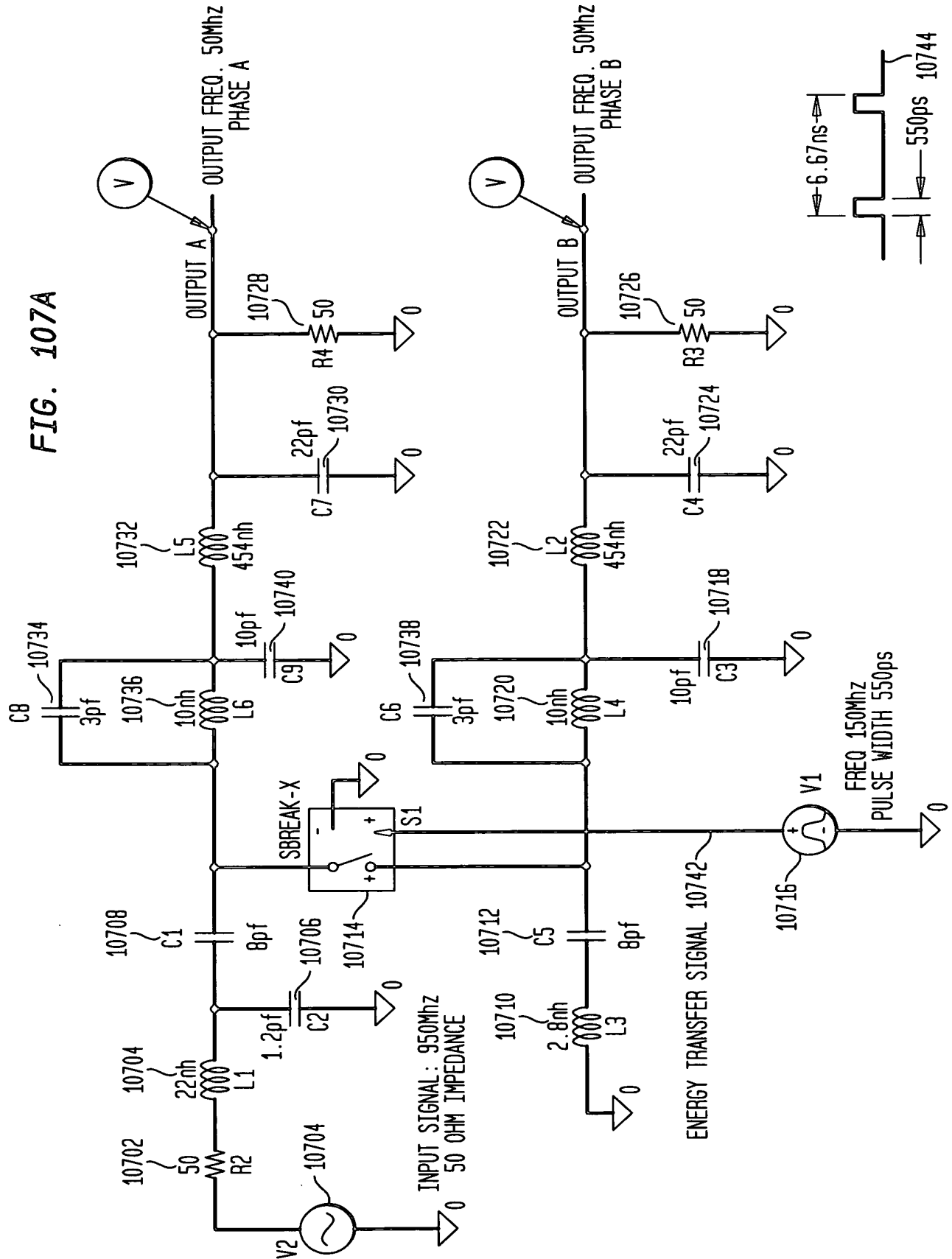


FIG. 107B

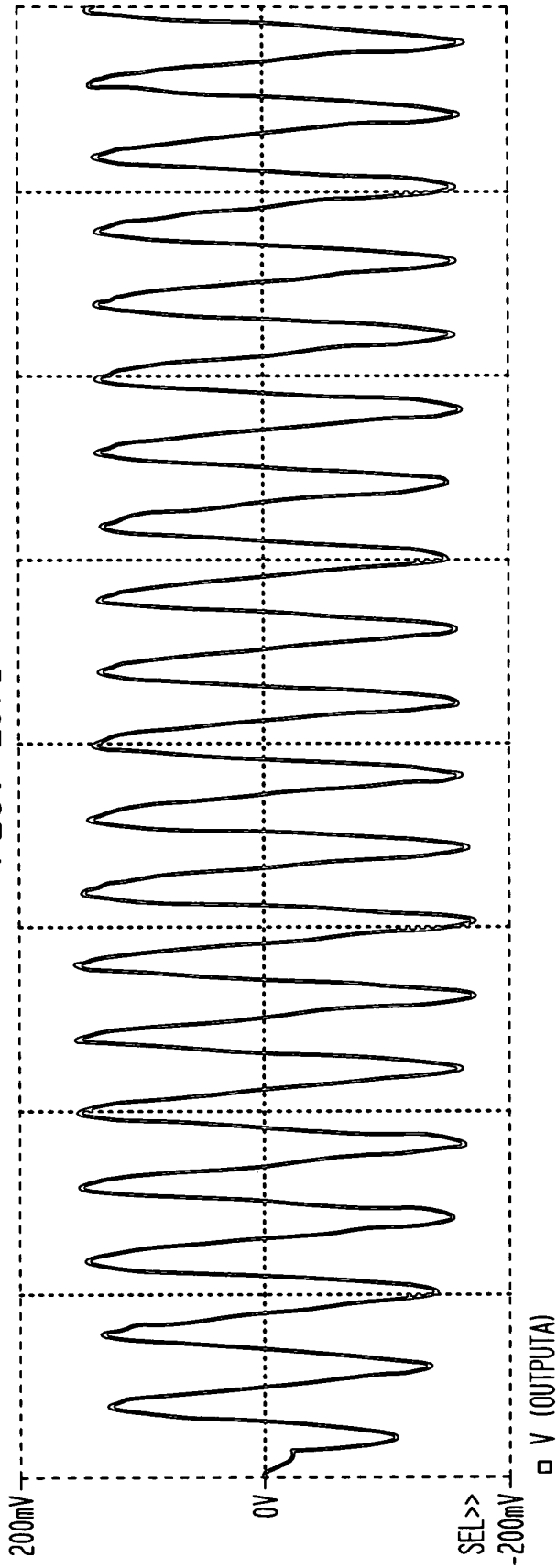


FIG. 107C

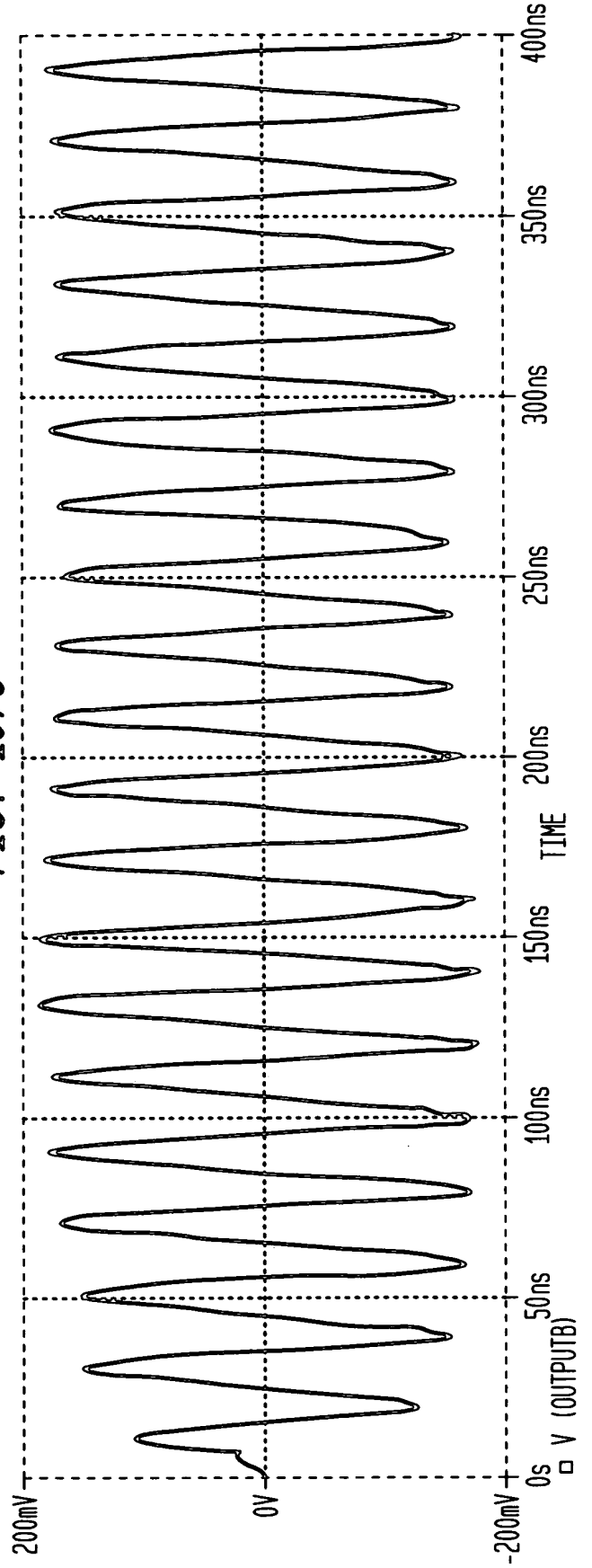


FIG. 108

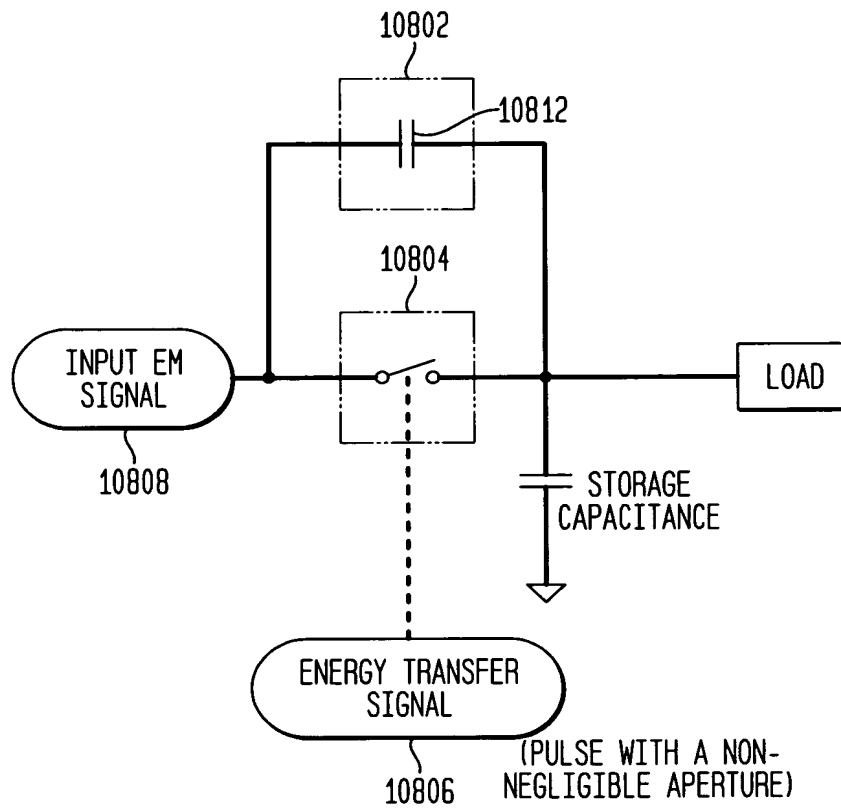


FIG. 109

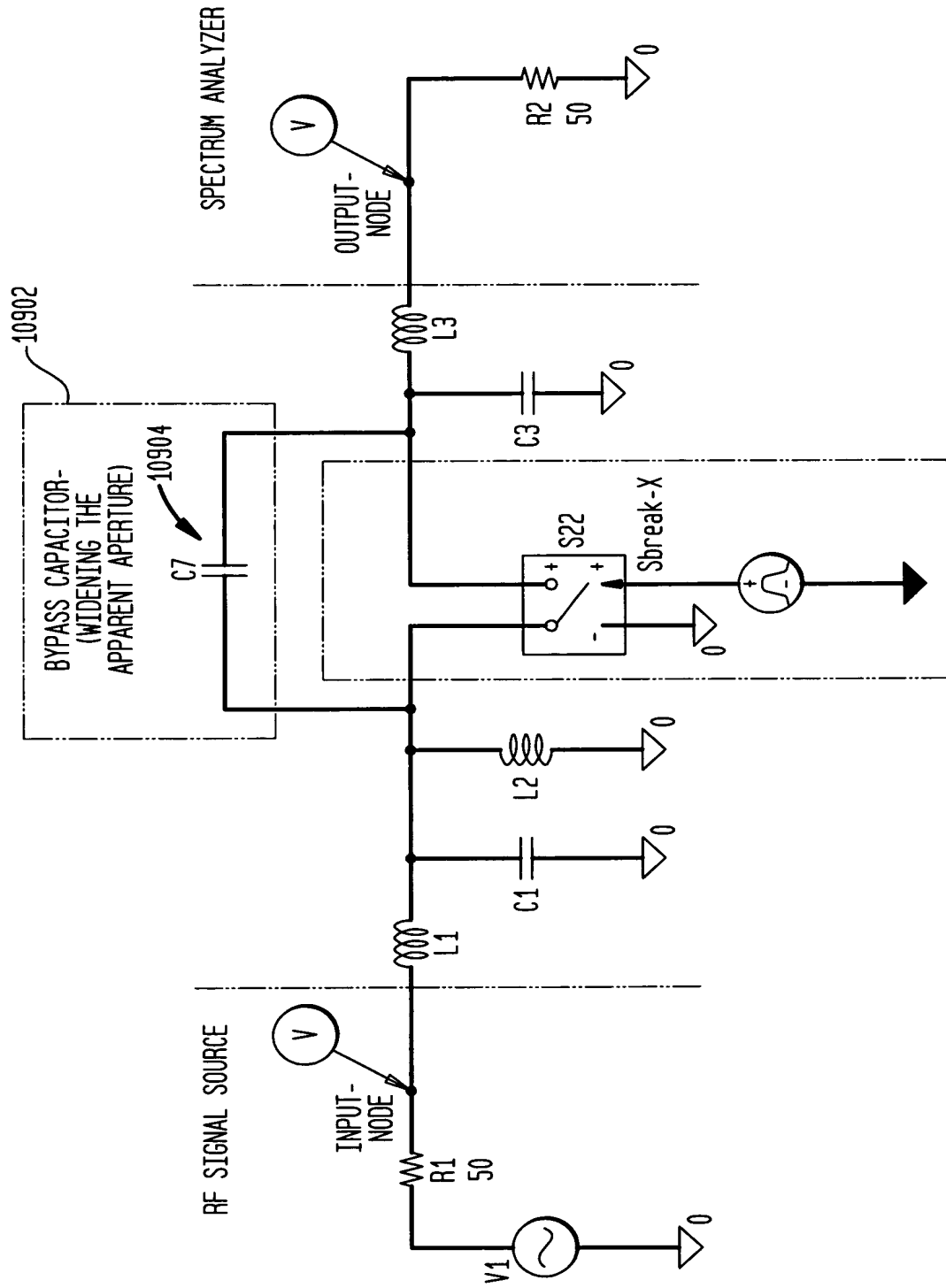


FIG. 110

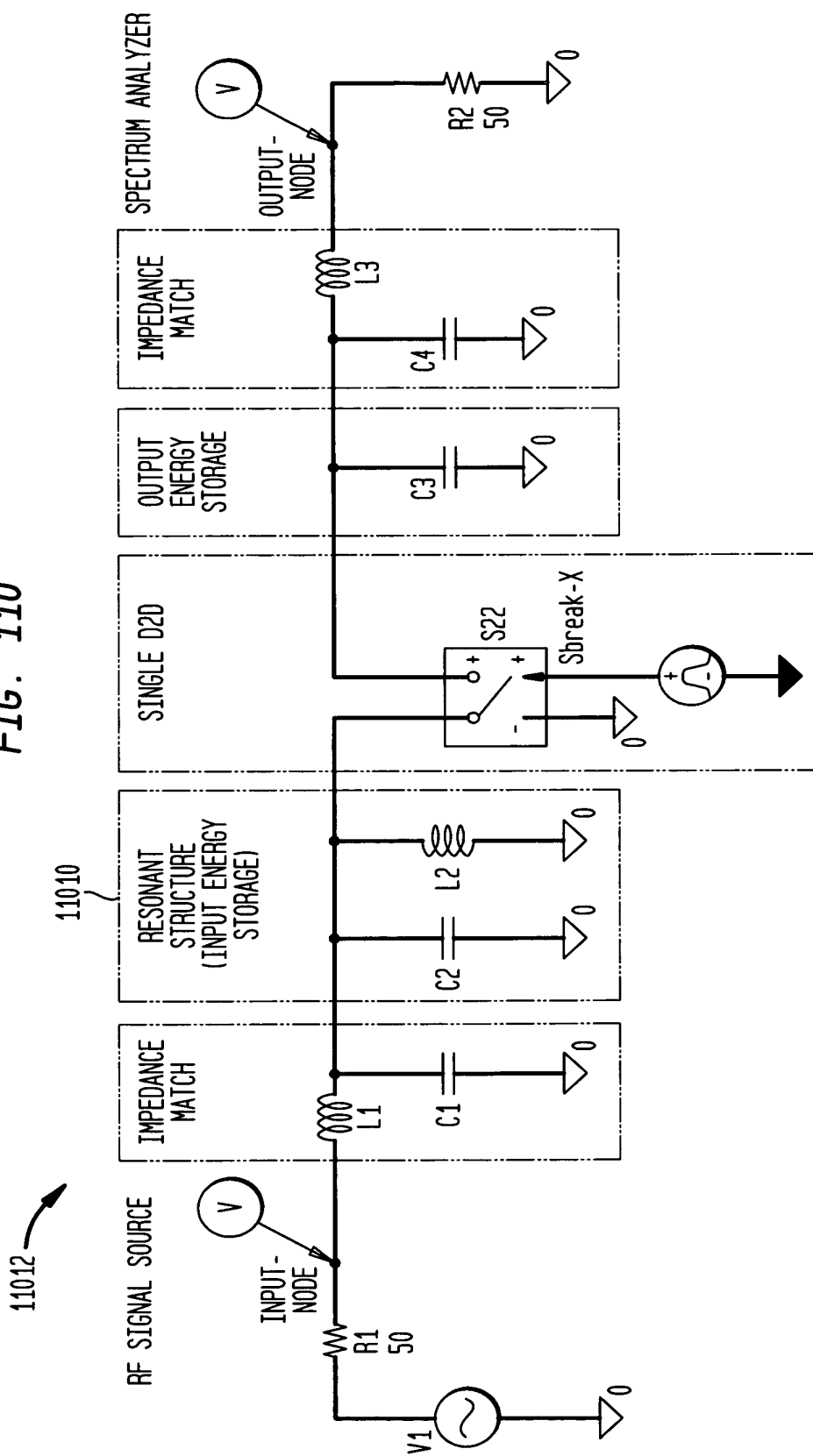
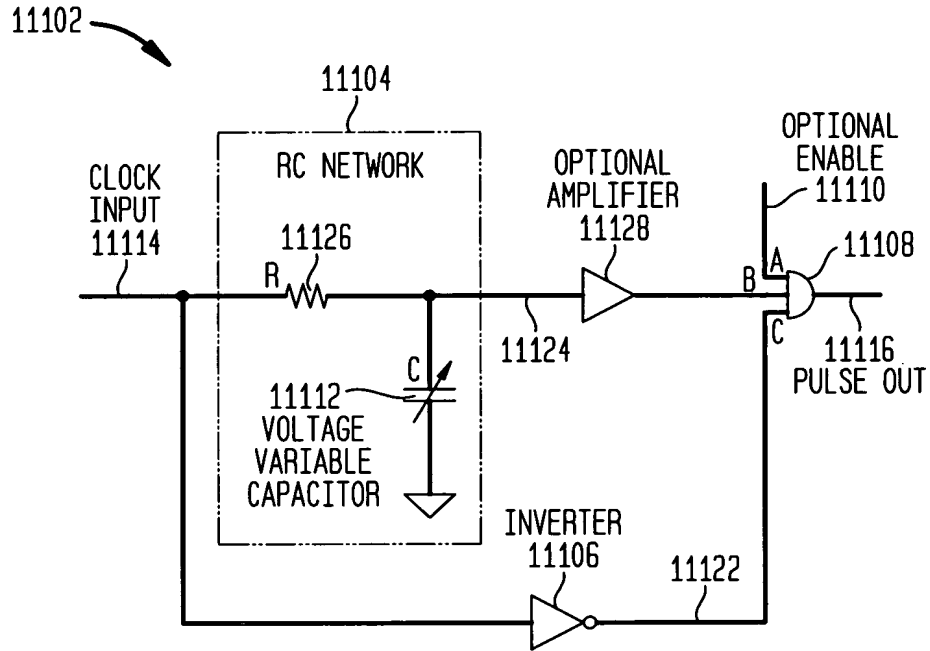


FIG. 111A



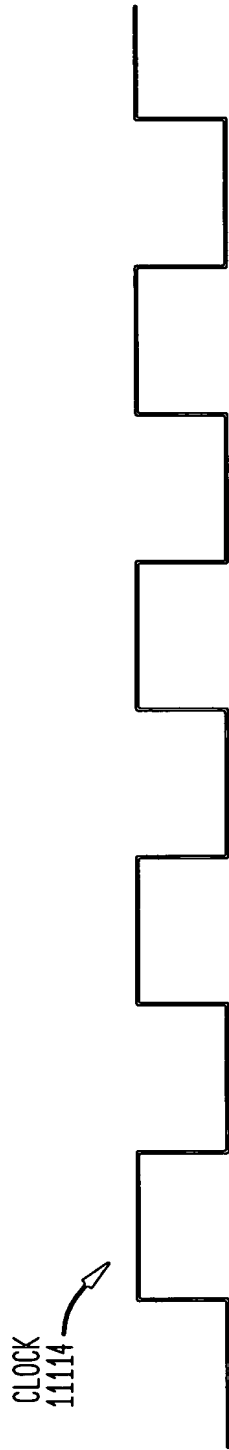


FIG. 111B

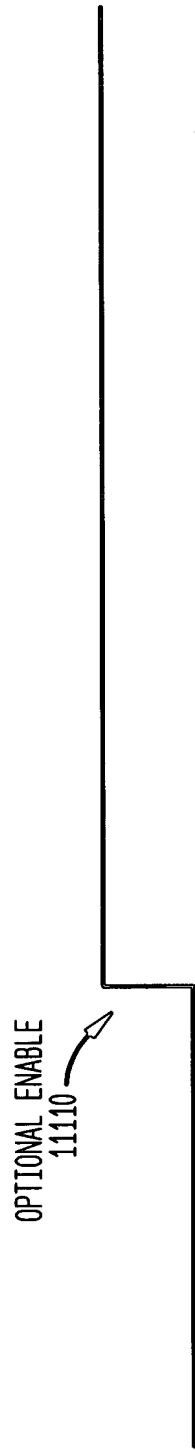


FIG. 111C

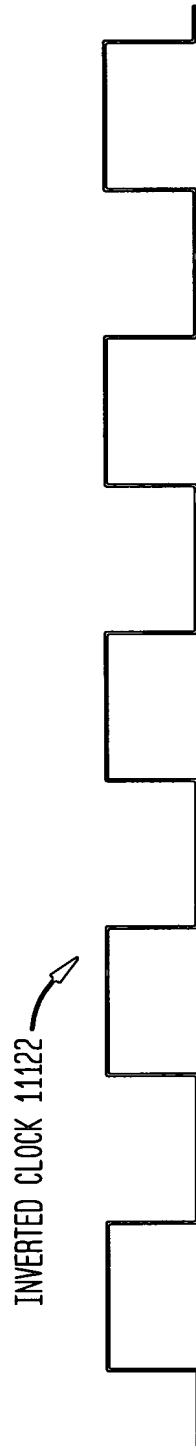


FIG. 111D

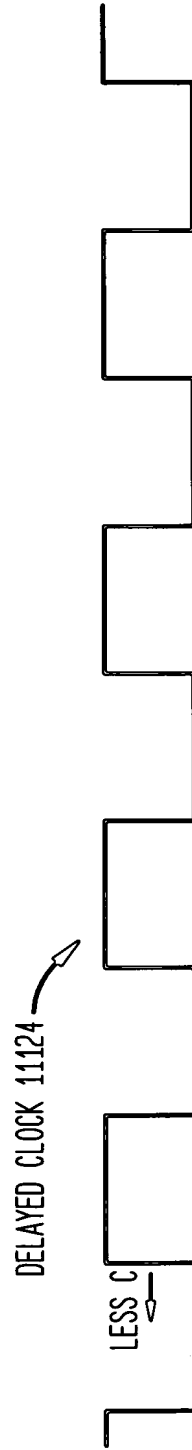


FIG. 111E

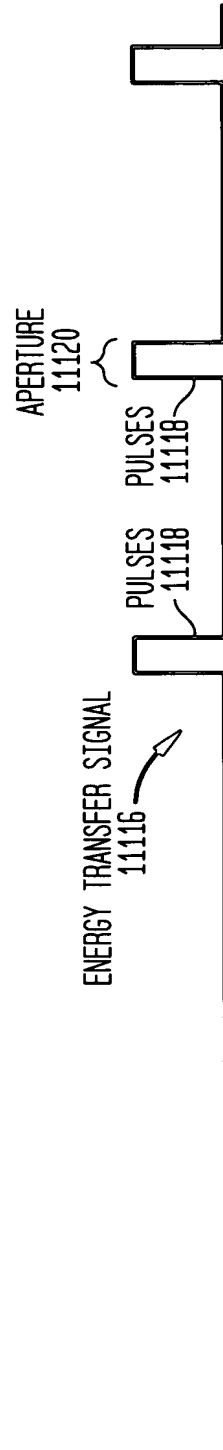


FIG. 111F

FIG. 112

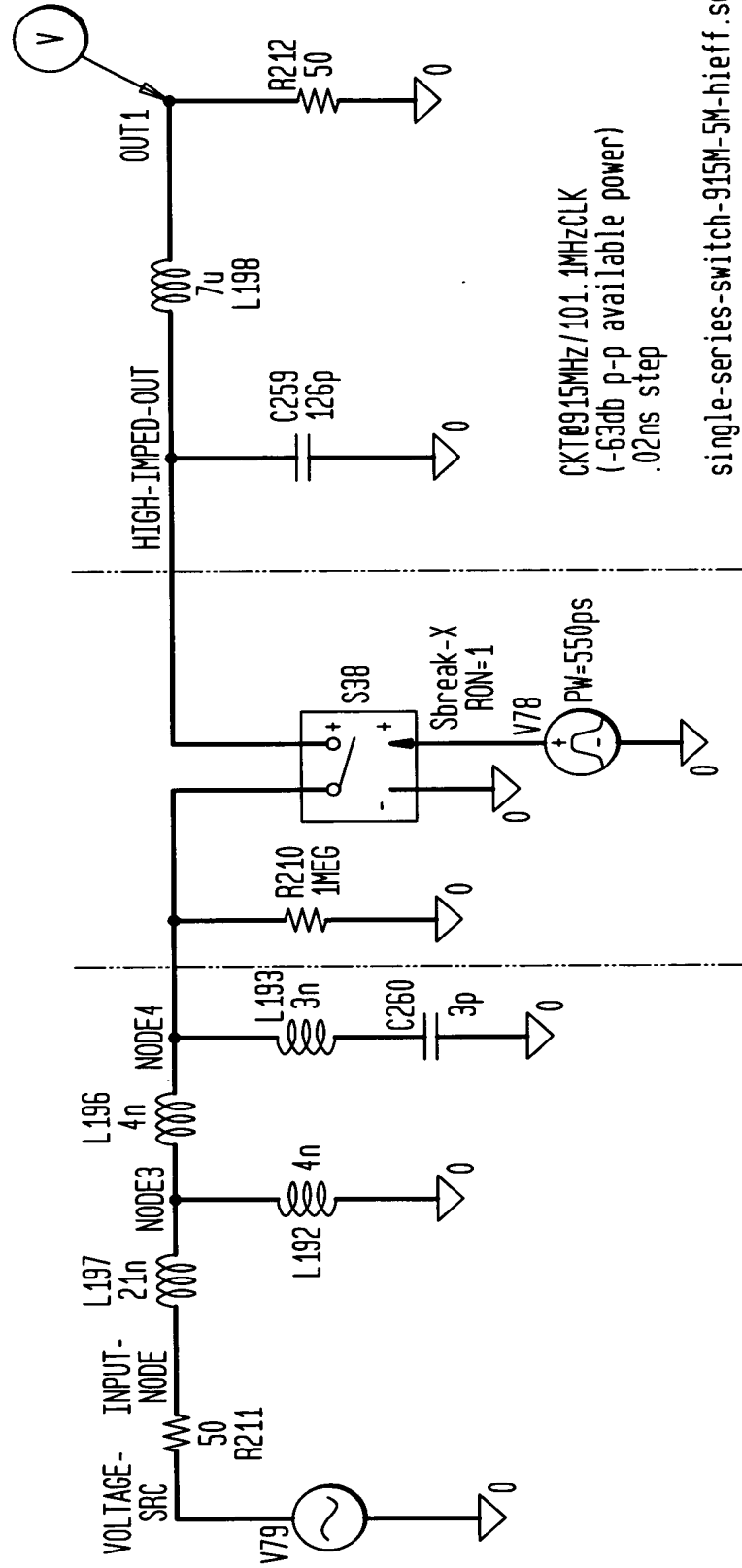


FIG. 113

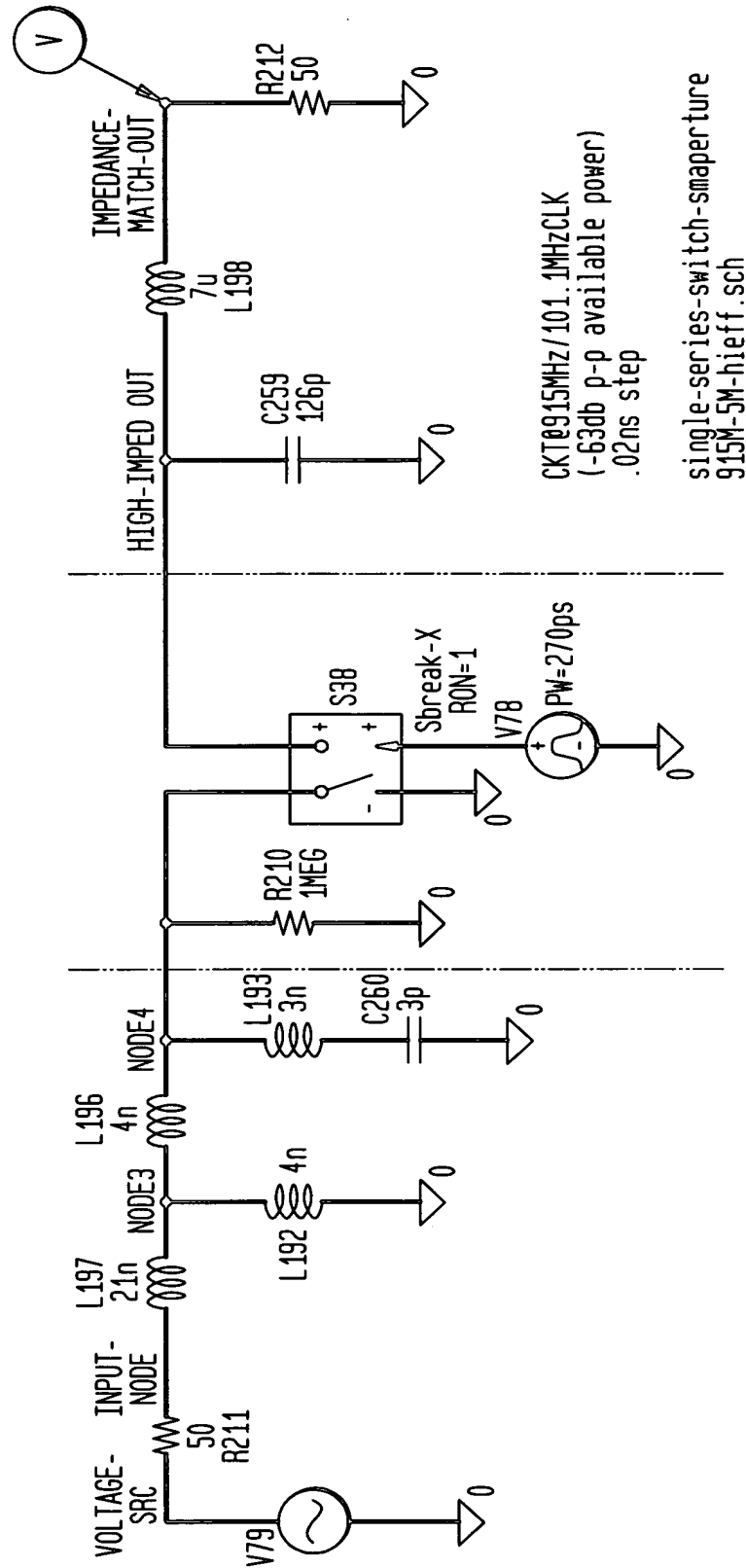


FIG. 114

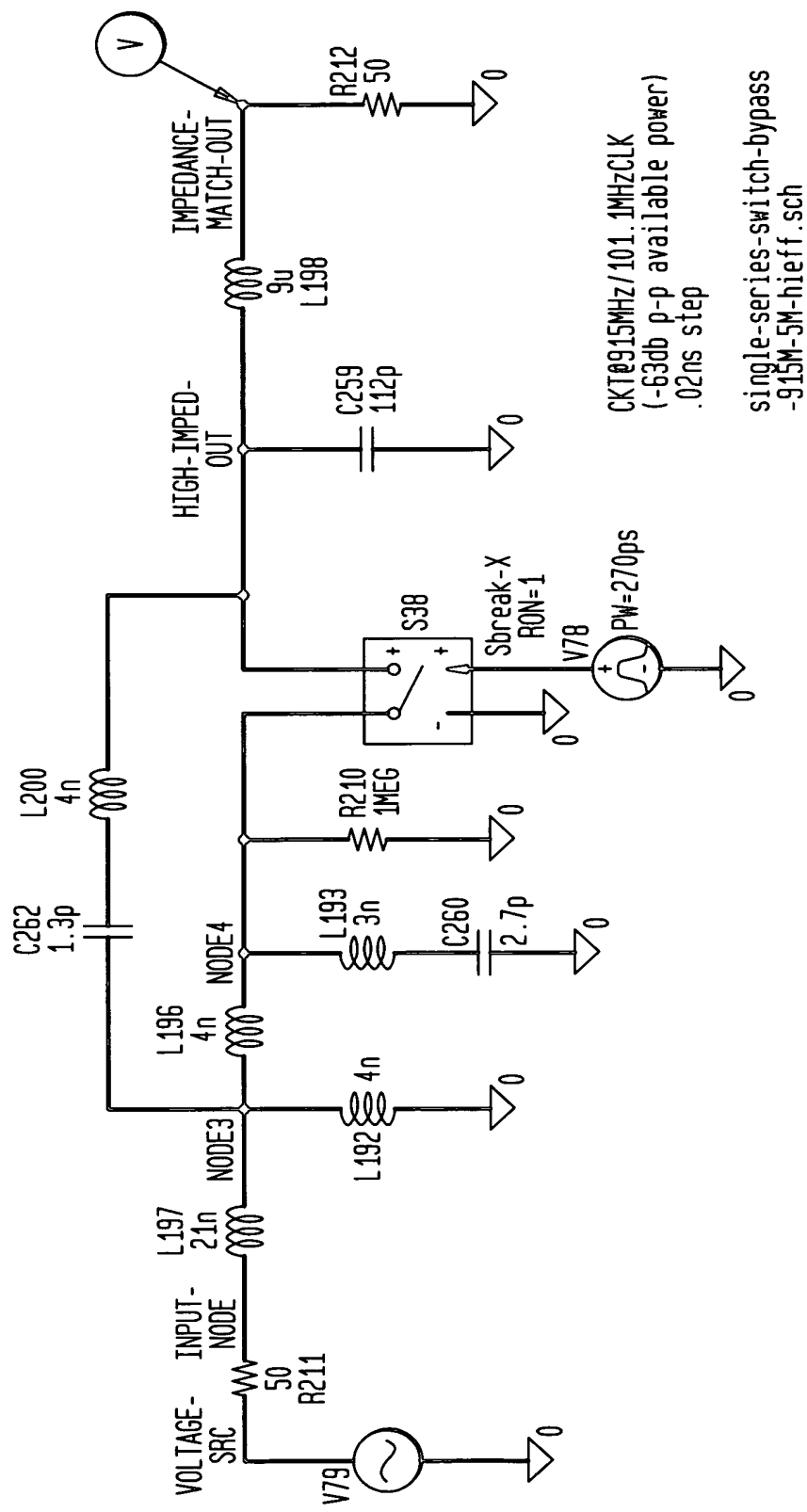


FIG. 115

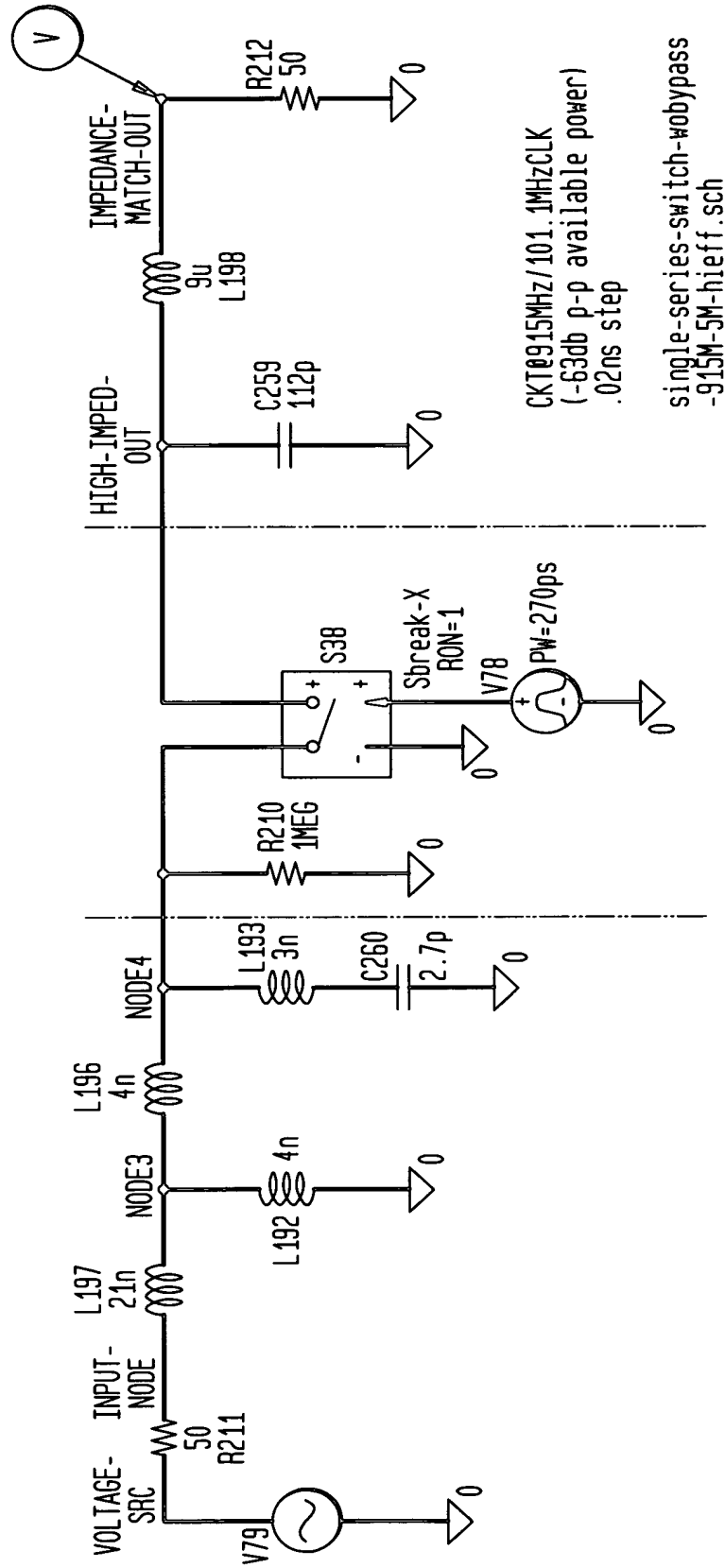
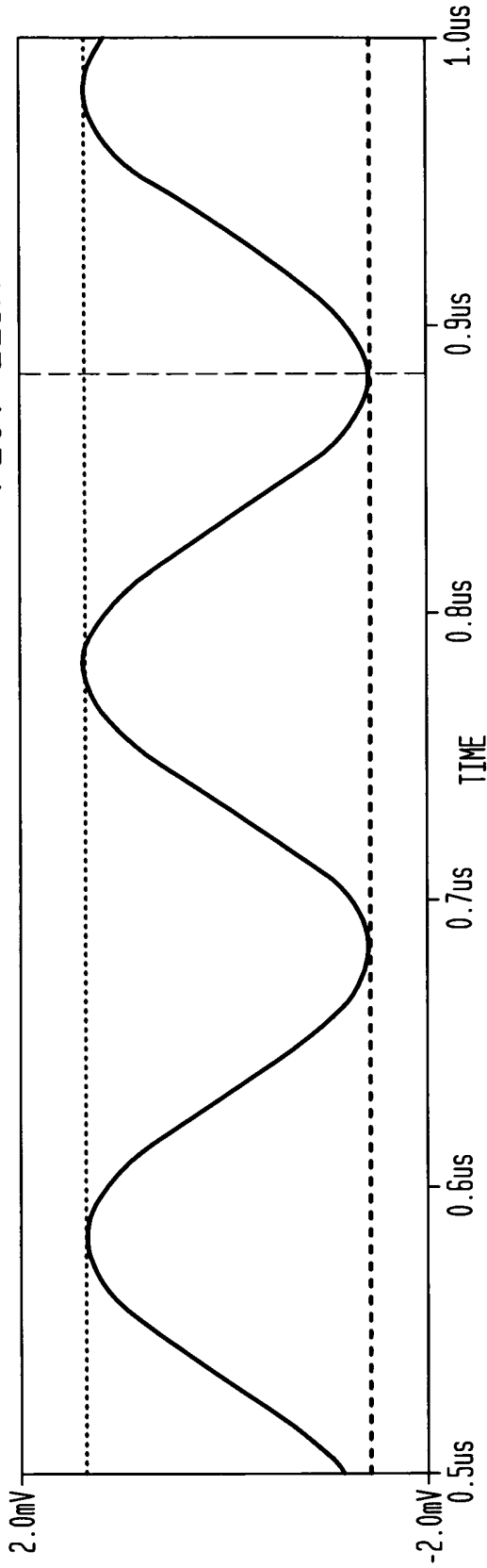


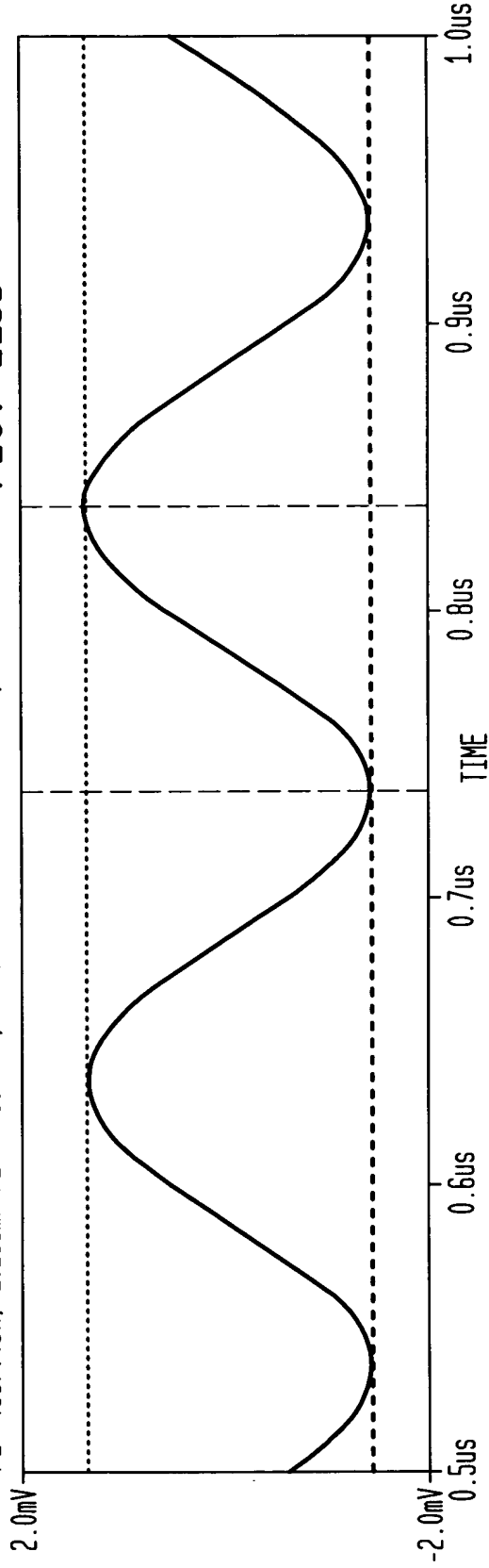
FIG. 116A



Ⓢ V(out1)

E1: (981.86n, 1.404m) E2: (883.04n, -1.402m) DIFF(E): (98.82n, 2.806m)
 F1: (837.43n, 1.253m) F2: (738.01n, -1.252m) DIFF(F): (99.42n, 2.505m)

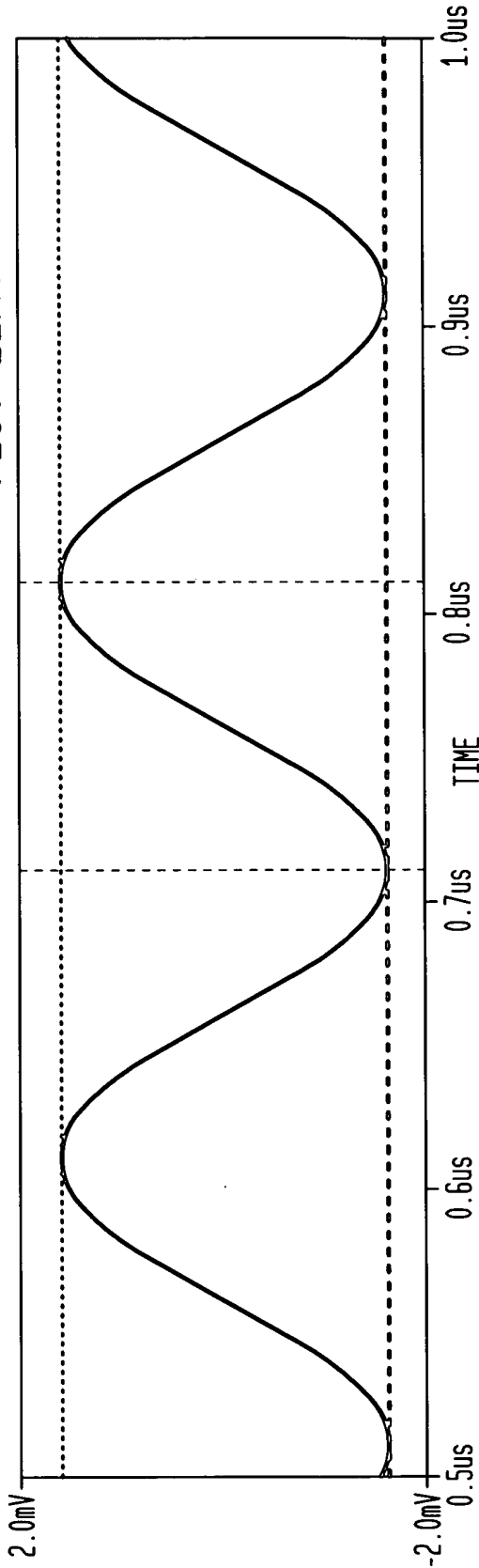
FIG. 116B



Ⓢ V(impedance-match-out)

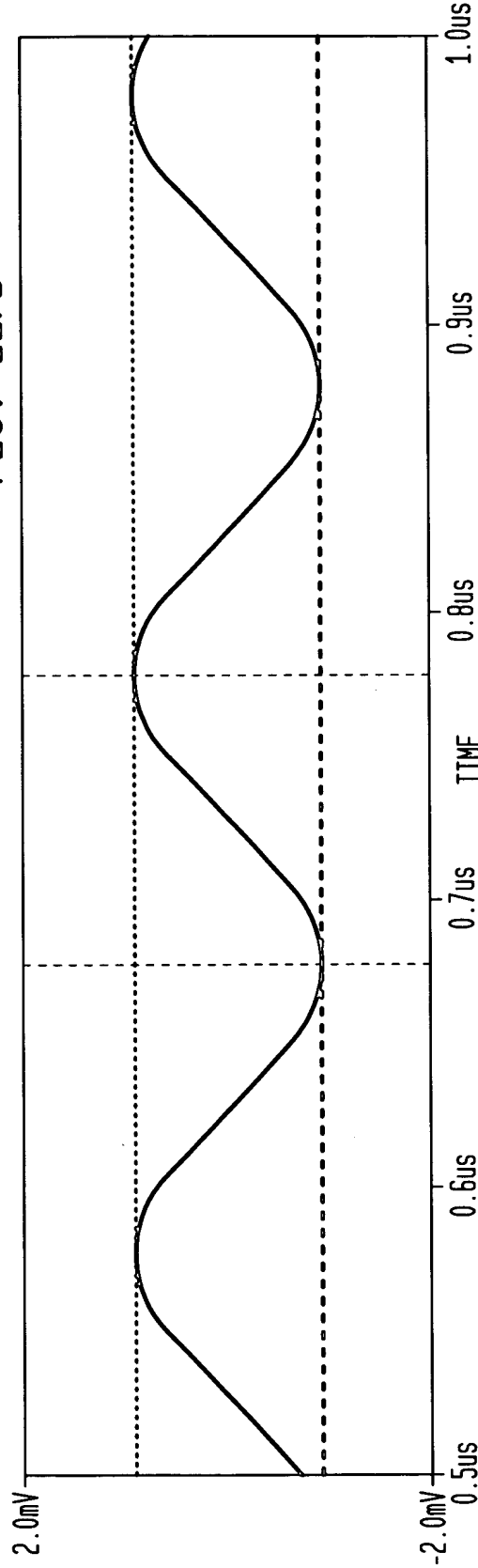
E1: (981.86n, 1.404m) E2: (883.04n, -1.402m) DIFF(E): (98.82n, 2.806m)
 F1: (837.43n, 1.253m) F2: (738.01n, -1.252m) DIFF(F): (99.42n, 2.505m)

FIG. 117A



□ V(impedance-match-out)
 A1: (810.53n, 1.642m) A2: (710.52n, -1.621m) DIFF(A): (100.01n, 3.263m)
 B1: (777.78n, 942.32u) B2: (677.18n, -942.51u) DIFF(B): (100.60n, 1.885m)

FIG. 117B



□ V(impedance-match-out)
 A1: (810.53n, 1.642m) A2: (710.52n, -1.621m) DIFF(A): (100.01n, 3.263m)
 B1: (777.78n, 942.32u) B2: (677.18n, -942.51u) DIFF(B): (100.60n, 1.885m)

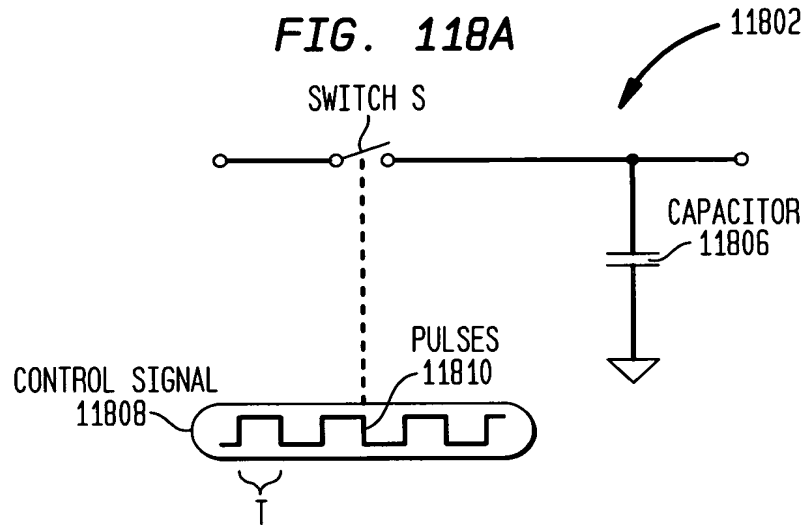


FIG. 118B

$q = C \cdot V$	EQ. A
$V = A \cdot \sin(t)$	EQ. B
$q(t) = C \cdot A \cdot \sin(t)$	EQ. C
$\Delta q(t) = C \cdot A \cdot \sin(t) - C \cdot A \cdot \sin(t-T)$	EQ. D
$\Delta q(t) = C \cdot A \cdot (\sin(t) - \sin(t-T))$	EQ. E
$\sin(\alpha) - \sin(\beta) = 2 \cdot \sin\left(\frac{\alpha - \beta}{2}\right) \cdot \cos\left(\frac{\alpha + \beta}{2}\right)$	EQ. F
$\Delta q(t) = 2 \cdot C \cdot A \cdot \sin\left[\frac{t - (t-T)}{2}\right] \cdot \cos\left[\frac{t + (t-T)}{2}\right]$	EQ. G
$\Delta q(t) = 2 \cdot C \cdot A \cdot \sin\left(\frac{1}{2} \cdot T\right) \cdot \cos\left(t - \frac{1}{2} \cdot T\right)$	EQ. H
$q(t) = \int C \cdot A \cdot (\sin(t) - \sin(t-T)) dt$	EQ. I
$q(t) = -\cos(t) \cdot C \cdot A + \cos(t-T) \cdot C \cdot A$	EQ. J
$q(t) = C \cdot A \cdot (\cos(t-T) - \cos(t))$	EQ. K

FIG. 118C

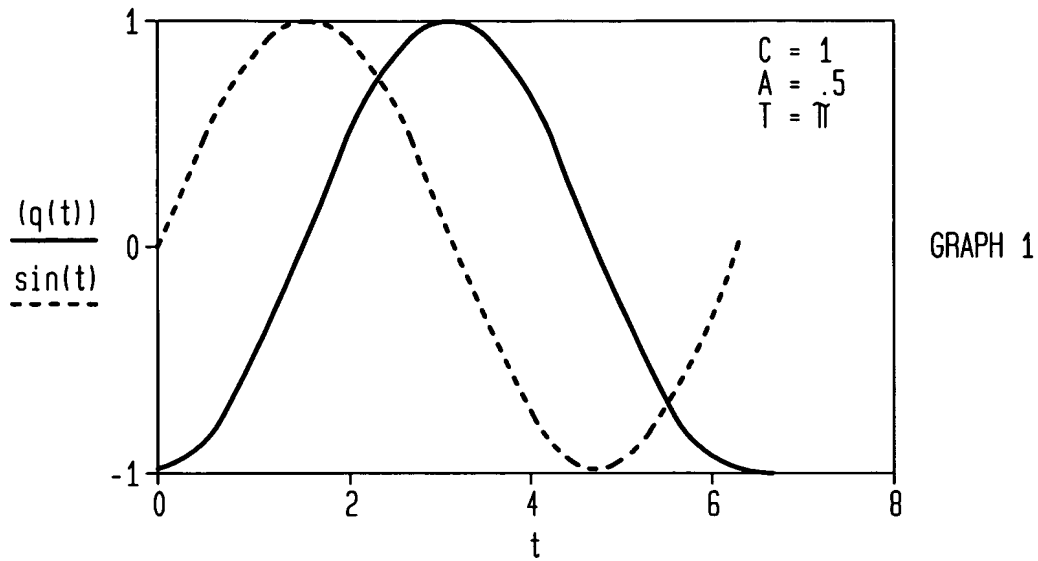


FIG. 118D

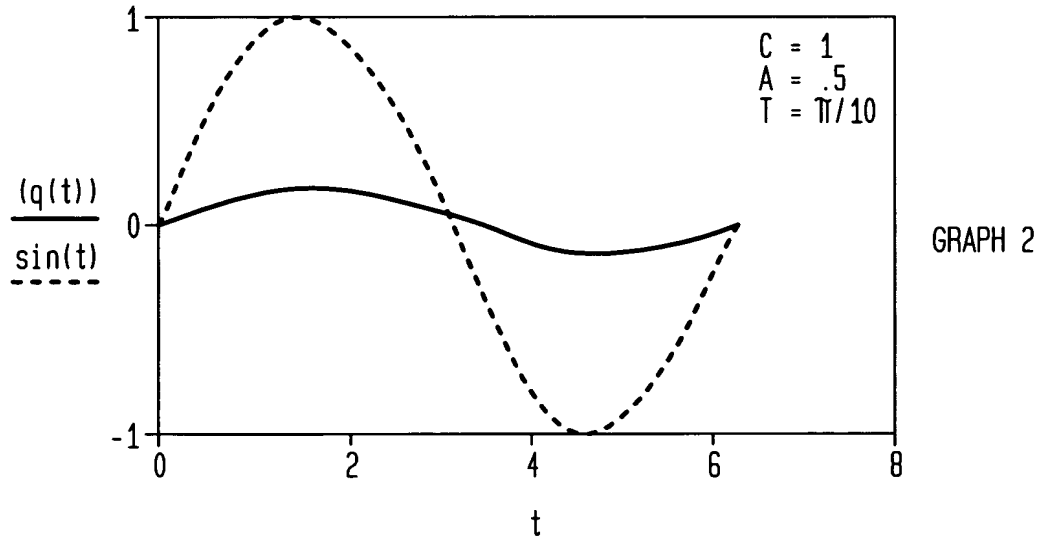


FIG. 118E

POWER-CHARGE RELATIONSHIP

$q = C \cdot V$	EQ. L
$V = q/C$	EQ. M
$V = J/C$	EQ. N
$J = q^2/C$	EQ. O
$P = J/S$	EQ. P
$P = \frac{q^2}{C \cdot S}$	EQ. Q

FIG. 118F

INSERTION LOSS

INSERTION LOSS IN dB IS EXPRESSED BY:

$$IL_{dB} = 10 \cdot \log\left(\frac{P_{in}}{P_{out}}\right) \text{ or}$$

$$IL_{dB} = 10 \cdot \log\left[\frac{\left(\frac{V_{in}^2}{R_{in}}\right)}{\left(\frac{V_{out}^2}{R_{out}}\right)}\right]$$

FIG. 119

